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The Hidden Psychological Cost of Educational AI: Associations Between AI Involvement, Teachers' Pride, and Meaningfulness at Work

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Abstract

The proliferation of generative AI tools in educational settings raises a fundamental but underexplored question: does delegating creative teaching tasks to AI erode the psychological rewards that make teaching meaningful? In the current research, we advance a dual-level framework distinguishing the immediate emotional costs of AI involvement at the task level from its broader costs at the career level. We tested this framework across two complementary studies. Study 1 was a randomized experiment ($N = 101$ high school teachers) where participants either designed a classroom activity independently or revised an AI-generated draft. Teachers who revised the AI-generated draft reported lower psychological ownership of the product, which partially accounted for their lower state pride; this indirect effect was stronger among teachers with stronger callings. Study 2 was a two-wave time-lagged field survey ($N = 231$ university teachers) examining habitual AI involvement and career calling at Time 1 and psychological ownership and work meaningfulness one month later. AI involvement was indirectly associated with lower work meaningfulness through lower psychological ownership, with the indirect effect stronger among teachers with stronger callings. Together, the two studies provide experimental (Study 1) and time-lagged correlational (Study 2) evidence that AI involvement is associated with lower psychological ownership, which in turn is linked to lower pride in a specific task and lower meaningfulness of work as a whole. These associations were stronger among teachers with stronger callings, suggesting an ironic vulnerability that warrants attention in educational AI policy, teacher professional development, and AI system design.

Keywords: artificial intelligence (AI); psychological ownership; state pride; work meaningfulness; calling; teachers

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1. Introduction

Teaching has long been considered among the most meaning-laden of human occupations because professional fulfilment derives not merely from task completion, but from the deeply personal act of crafting knowledge, shaping minds, and leaving an intellectual imprint on students' growth (Collins et al., 2011; Nguyen & Habók, 2024; Yu et al., 2026). Yet the rapid proliferation of generative artificial intelligence (AI) tools in educational settings is quietly transforming the nature of this work (Akram et al., 2022; Esteve-Mon et al., 2020). Teachers increasingly use AI to draft lesson plans, generate assessment items, and compose individualized student feedback—tasks that once constituted the creative core of

their professional contribution (Y. Li & Khairani, 2026; Rowan et al., 2021). As AI becomes capable of producing in seconds what teachers once spent hours crafting, a question of fundamental psychological importance emerges: when AI does the intellectual work, does teaching still feel like *theirs*?

This question sits at the intersection of two bodies of research that have rarely been connected (H. Li et al., 2025). Research on AI in education has focused mainly on outcomes for students, such as learning achievement, engagement, and equity (Zawacki-Richter et al., 2019), treating teachers primarily as implementers of technology rather than as people whose own psychological experience is shaped by AI adoption. In parallel, research on creative and knowledge work has begun to examine how generative AI changes the experience of work. For example, access to AI-generated ideas enhances individual creativity but reduces the diversity of collective output (Doshi & Hauser, 2024), and people who write with AI report lower psychological ownership of the resulting text—that is, a weaker feeling, in Pierce et al.'s (2001) terms, that "this is mine" (Draxler et al., 2024). Psychological ownership has also been examined as a factor in consumers' adoption of AI chatbots (Scarpi, 2024). Neither literature, however, has examined the psychological experience of teachers, whose professional identity, sense of calling, and experience of meaningful work are closely tied to the belief that their personal contribution matters.

Psychological ownership theory provides the conceptual architecture needed to understand why AI involvement may be particularly costly for teachers. Pierce et al. (2001) identify three routes through which ownership feelings develop: perceived control over a target, intimate knowledge of it, and personal self-investment in creating it (Dawkins et al., 2017). We propose that each of these routes may be disrupted when AI intervenes in teaching tasks. When an AI generates a lesson plan, the teacher does not exercise full creative control; when AI produces individualized student feedback, the teacher's domain expertise is partially supplanted by machine output; when a complete assessment is AI-generated, the teacher's effortful cognitive investment, the very process that makes the outcome feel personally authored, is bypassed (Lawrence et al., 2024). We therefore expect AI involvement to reduce teachers' psychological ownership of their work (Barnes & Tour, 2026). From a self-determination perspective, this erosion of personal authorship may also frustrate the needs for competence (as teachers can no longer unambiguously attribute outcomes to their own expertise) and autonomy (as algorithmic defaults supplant deliberate professional choices). We draw on these processes to explain, rather than directly test, why reduced ownership may diminish the psychological rewards of teaching.

Teachers are not merely a convenient sample through which to test a general mechanism; they constitute a theoretically privileged population in which this mechanism should operate with particular force. Teaching is among the occupations most commonly experienced as a calling (Lobene & Meade, 2013; Wu et al., 2024), which is defined as a profound sense of purpose, transcendent meaning, and destiny in one's professional role (Dik et al., 2012). When work is experienced as a calling, the connection between personal effort and meaningful outcomes is not merely instrumental but constitutive: the teacher's sense of who they are is bound up with the belief that their personal contribution is what makes a difference to students (Ehrhardt & Ensher, 2021; Fouché et al., 2017). The capacity of AI to produce high-quality teaching outputs without the teacher's substantive intellectual involvement therefore poses a challenge that goes beyond workload redistribution and may threaten the very causal narrative that anchors professional identity (Ghiasvand & Seyri, 2025; Lan, 2024). We theorize that teachers who experience stronger callings are not protected from this threat but are, paradoxically, more exposed to it: because their sense of meaning is more deeply invested in personal authorship, the dilution of that authorship by AI is more psychologically consequential.

Despite the urgency of these questions, limited research has examined how AI involvement in teaching tasks affects teachers' psychological ownership or its downstream psychological consequences. This gap is substantively important for three reasons. First, it leaves psychological ownership theory without an account of a potentially important new antecedent of lower ownership: the delegation of cognitive labor to AI (Lan, 2024). Second, it leaves the educational psychology literature without an account of how AI adoption affects teachers' internal states—not their pedagogical behaviors or student outcomes, but the quality of their own professional psychological experience (Lawrence et al., 2024). Third, and most practically, it means that educational institutions are currently scaling AI adoption in teaching without strong empirical evidence about whether, for whom, and under what conditions this adoption imposes psychological costs on the teachers themselves (Peng & Wan, 2025; H. Zhang et al., 2025).

To address this gap, we advance a dual-level framework that distinguishes the psychological effects of AI on teachers at two levels: a specific task and one's work as a whole. At the task level, AI involvement may have immediate, situation-specific consequences. State pride, an acute self-evaluative emotion that follows personal achievement (Tracy & Robins, 2007), operates on this short time scale: it requires a perceivable link between personal effort and outcome, and it dissipates rapidly (Etherington, 2019). Consequently, a single episode of AI assistance may attenuate this in-the-moment pride by disrupting the sense of personal authorship. At the career level, by contrast, the relevant outcome is work meaningfulness, a perception that one's occupation as a whole is significant and purposeful, which prior work conceptualizes as relatively enduring (Steger et al., 2012). Because this perception is thought to be shaped by repeated professional experiences rather than by a single episode, we propose that habitual reliance on AI across teaching tasks may be associated with lower ownership of one's teaching work and, through it, lower meaningfulness. These two levels call for different designs. An experiment can isolate the immediate effect of AI involvement in a single task but is ill-suited to a work-wide perception that is assumed to change slowly—an assumption drawn from prior theorizing rather than tested here, whereas a field survey can capture work-wide perceptions in teachers' actual practice but cannot isolate causal effects. We therefore combine the two approaches.

We conducted two studies for the current research, each designed to address one of these levels with the methodology it demands. Study 1 is an experiment in which in-service teachers are randomly assigned to complete a classroom-activity design task under one of two conditions: AI-assisted involvement, or AI-assisted completion. Immediately following task completion, we measure psychological ownership and state pride, allowing us to test whether AI involvement causally reduces ownership and pride, and whether ownership statistically accounts for the effect on pride. Study 2 is a two-wave, time-lagged field survey administered to a separate sample of in-service teachers at one university, with AI involvement in teaching tasks measured at Time 1 and psychological ownership and work meaningfulness measured one month later at Time 2. Separating the measurement of AI involvement from that of ownership and meaningfulness by one month establishes temporal precedence of the predictor and reduces common method bias, although it does not allow us to assess change in ownership or meaningfulness. Across both studies, we examine calling as a moderator of the relationship between AI involvement and psychological ownership by exploring whether teachers with stronger callings show a stronger negative association between AI involvement and ownership, and thus greater downstream psychological costs.

This research makes three contributions to the literature. First, we extend psychological ownership theory to the domain of human-AI collaboration in educational work, identifying AI involvement as an antecedent of lower psychological ownership and examining how lower ownership relates to psychological costs at the task and career levels (Y. Li & Khairani,

2026). Second, we introduce a dual-level framework (i.e., distinguishing task-level emotional costs from career-level costs) that we propose as a useful conceptual tool for future research on the psychological effects of AI on knowledge workers more broadly (Scarpi, 2024). Third, by positioning calling as a theoretically motivated moderator, we identify an ironic vulnerability (Dumulescu et al., 2025): the teachers most psychologically committed to their vocation may bear the highest psychological costs of AI adoption, with implications for teacher recruitment, professional development, and institutional AI policy.

2. Theory and Hypotheses Development

2.1. Theoretical Background

The present research draws on three theoretical frameworks that form a single interlocking explanatory chain rather than independent parallel accounts. Psychological ownership theory (Pierce et al., 2001) answers the question of why AI involvement is psychologically costly: it identifies the three experiential routes through which ownership feelings develop and suggests how AI may disrupt each of them. Self-determination theory (Deci & Ryan, 2012) offers an interpretive account of why ownership erosion may translate into psychological cost: it provides a need-based account of why the loss of authorship—specifically, the frustration of competence and autonomy needs—may translate into diminished emotional reward and career-level meaning. The theory of callings (Duffy et al., 2018) addresses the question of for whom these effects should be most pronounced: workers who experience their occupation as a calling, for whom personal authorship is tied to professional identity rather than being merely a means to an end. Each framework plays a distinct role, and together they yield predictions that none would generate on its own. Note that the present studies directly test the links among AI involvement, psychological ownership, and its outcomes; the ownership routes and need-frustration processes serve as theoretical rationale and were not measured.

Psychological ownership theory holds that individuals develop feelings of possession toward targets they come to regard as extensions of the self (Pierce et al., 2001). Unlike legal ownership, psychological ownership is a subjective psychological state defined by the belief that a target is mine (L.-f. Zhang et al., 2024). Pierce and colleagues identify three principal experiential routes through which ownership feelings develop: exercising control over a target, coming to know it intimately, and investing oneself in its creation (Pierce & Jussila, 2011). When any of these routes is obstructed, psychological ownership over the resulting product is attenuated. The organizational psychology literature has documented the consequences of diminished ownership, including reduced job satisfaction, lower organizational commitment, and withdrawal from discretionary effort (Jami et al., 2021; Van Dyne & Pierce, 2004). However, prior research has examined ownership primarily as a function of organizational conditions such as job design and leader behavior. The present research is among the first to position AI involvement as a structural antecedent of ownership erosion in professional knowledge work.

Self-determination theory (Deci & Ryan, 2012) posits that well-being depends on the satisfaction of three basic psychological needs: autonomy, competence, and relatedness. We focus on competence and autonomy because they are the needs most directly implicated in personally authored work (Chiu et al., 2024): a teacher's confidence in his or her professional skill and sense of volitional control over teaching practice are what AI involvement may place at risk when it substitutes for personal effort (H. Li et al., 2025). When AI produces a lesson plan, feedback, or assessment, teachers may be unable to attribute the quality of the outcome unambiguously to their own skill, which threatens competence (Barnes & Tour, 2026); and when algorithmic generation replaces deliberate personal choice, autonomy may be compromised (Guo et al., 2025). Self-determination theory holds that chronic frustration

of these needs undermines intrinsic motivation and, ultimately, the sense that one's work is meaningful (Deci & Ryan, 2012; Steger et al., 2012). Psychological ownership theory thus suggests why AI involvement may weaken the sense of personal authorship, and self-determination theory suggests why this weakening may be psychologically costly—an account that we use to interpret, rather than to test, the proposed links.

The theory of callings (Dobrow & Tosti-Kharas, 2011; Marsh & Dik, 2026) provides the moderating framework. A calling is characterized by a sense of purposive transcendence, the conviction that one is destined to occupy a particular role, and a deep orientation toward the greater good through one's work (Duffy et al., 2018). For teachers who experience their work as a calling, the link between personal effort and meaningful contribution to students is not merely instrumental but constitutive of their professional identity (Dumulescu et al., 2025; Wu et al., 2024). Calling theory therefore predicts an ironic vulnerability: teachers with the strongest callings are most deeply invested in the causal narrative that personal effort produces meaningful outcomes, making them most sensitive to AI's disruption of that narrative. Importantly, this moderation prediction does not follow from psychological ownership theory or self-determination theory alone, which do not specify for whom the loss of personal authorship should matter more. Calling theory adds the insight that for some workers, personal authorship is closely tied to professional identity; for these workers, the same reduction in authorship should weigh more heavily. We therefore expect calling to amplify the negative effect of AI involvement on ownership.

2.2. AI Involvement and Psychological Ownership in Teaching

We define AI involvement in teaching as the degree to which a teacher relies on AI tools to generate, initiate, or substantially complete the cognitive outputs of their professional work, including but not limited to lesson planning, student assessment design, and personalized feedback. At higher levels of AI involvement, the three routes through which psychological ownership develops are likely to be weakened (Gomez et al., 2023).

Control, the first route, may be attenuated when AI systems generate content, as the teacher shifts from being the primary agent of creation toward being an editor or approver of AI-generated material (Salisu et al., 2026). Intimate knowledge of the target, the second route, may also be weakened: deep familiarity with a piece of work typically develops through the iterative, effortful process of constructing it, a process that AI can shorten (Babu et al., 2025). The third route, self-investment, may be reduced when AI produces part of what would otherwise be the product of the teacher's own cognitive labor (Zhao et al., 2024). Pierce et al. (2001) argued that investing one's time, ideas, and energy into a target is among the most powerful sources of ownership feelings; when AI performs part of this cognitive work, the subjective basis for feeling that the output is "mine" may be weakened. We note that these routes are proposed as explanations and were not measured in the present studies.

Consistent with recent experimental evidence from writing tasks showing that AI-generated text significantly reduces authors' psychological ownership relative to self-authored text (Draxler et al., 2024; Scarpi, 2024), we predict that in the domain of teaching, greater AI involvement will yield lower psychological ownership over the resulting work products. This prediction applies both to single-task AI involvement, as manipulated in Study 1, and to habitual AI involvement across teaching tasks, as measured in Study 2.

H1. *AI involvement in teaching tasks will negatively predict psychological ownership of task outcomes: greater AI involvement will be associated with lower psychological ownership (Study 1, experimentally; Study 2, time-lagged).*

2.3. The Task-Level Pathway: Psychological Ownership and State Pride

At the task level, we theorize that psychological ownership erosion translates into diminished state pride immediately following task completion. State pride is the acute, situationally elicited positive self-evaluative emotion that arises from perceived personal accomplishment (Tracy & Robins, 2007). Unlike trait or dispositional pride, state pride is specifically responsive to the attributional context of a given achievement: it requires that the individual perceive the outcome as internally caused and as reflecting positively on personal ability or effort (Schilpzand et al., 2025). These attributional requirements forge a direct theoretical link between psychological ownership and state pride.

The feeling that a work product is mine is precisely the subjective condition that licenses the self-attribution underlying state pride (Watkins et al., 2023). A teacher who completes a lesson plan independently, investing cognitive effort and domain expertise, experiences the plan as their own creation and therefore as a valid basis for self-evaluative pride. When AI substantially generates the same plan, the teacher cannot make the same attribution with confidence: the competence and effort that the outcome reflects are at least partially those of the AI system rather than the teacher's own. Psychological ownership theory and self-attribution theory (Weiner, 1985) converge on the prediction that this attributional ambiguity will attenuate state pride.

This reasoning aligns with research showing that individuals derive less satisfaction and emotional reward from outcomes they did not personally author, even when the quality of those outcomes is held constant (Morewedge et al., 2021; Norton et al., 2012). In the specific context of AI collaboration, Doshi and Hauser (2024) found that AI assistance altered the emotional texture of creative work, and studies of AI-assisted writing have documented reduced feelings of personal accomplishment associated with AI-generated outputs. We test this mediation hypothesis in Study 1. Because AI involvement, but not ownership, was manipulated, the experiment supports causal inference about the effect of AI involvement on ownership and pride, whereas the ownership-to-pride link remains correlational.

H2. *Psychological ownership will mediate the negative relationship between AI involvement and state pride: greater AI involvement will predict lower psychological ownership, which in turn will predict lower state pride. This indirect effect will be tested in Study 1 using experimental mediation.*

2.4. The Career-Level Pathway: Psychological Ownership and Work Meaningfulness

A distinct but complementary question concerns the career-level correlates of habitual AI involvement (Pandya & Wang, 2024). We propose that when AI involvement in teaching tasks becomes a sustained pattern rather than an isolated event, teachers may come to feel less ownership of their teaching work as a whole, which may in turn weaken their perception that this work is meaningful. This proposed accumulation is a theoretical assumption; the present research tests whether habitual AI involvement predicts lower ownership and meaningfulness, not the process of change itself.

Work meaningfulness captures a positively valenced appraisal of one's occupation along three interrelated dimensions: the belief that work provides positive personal meaning, that it serves as a vehicle for ongoing meaning-making and self-understanding, and that it contributes to a purpose greater than the self (Steger et al., 2012). Unlike state-level emotional responses such as pride, this appraisal refers to one's work as a whole rather than to a single episode, and it is conceptualized as relatively enduring (Steger et al., 2012; Blustein et al., 2023). Its development depends on the repeated experience of work as personally authored, effortful, and consequential (Cnossen & Nikolova, 2025).

Self-determination theory provides the explanatory bridge between lower ownership and lower meaningfulness (Autin et al., 2022). Ryan and Deci (2000) argued that au-

tonomous motivation and its downstream well-being effects depend on activities being experienced as genuinely self-determined and competence-affirming. When habitual AI involvement persistently short-circuits teachers' self-investment in their core professional tasks, the need for competence may be undermined: teachers can no longer clearly attribute professional outcomes to their own expertise (H. Li et al., 2025). Simultaneously, the need for autonomy may be compromised as AI-generated defaults increasingly structure what teaching products look like (Yang, 2026). According to self-determination theory, chronic need frustration of this kind would erode intrinsic motivation and degrade the perception that work is meaningful (Autin et al., 2022).

Because individual instances of AI assistance are unlikely to shift a work-wide perception such as work meaningfulness (Steger et al., 2012), we examine this pathway in a field setting in Study 2, measuring habitual AI involvement at Time 1 and psychological ownership and work meaningfulness one month later at Time 2. Because work meaningfulness was measured only once, this design does not test whether work meaningfulness is stable or how it changes; it tests whether habitual AI involvement predicts lower ownership and meaningfulness one month later.

H3. *Psychological ownership will mediate the negative relationship between habitual AI involvement in teaching and work meaningfulness: AI involvement will predict lower psychological ownership, which in turn will predict lower work meaningfulness. This indirect effect will be tested in Study 2 using a two-wave design.*

2.5. The Moderating Role of Calling

The hypotheses advanced thus far treat the effect of AI involvement on psychological ownership as uniform across teachers. We further argue that the magnitude of this effect depends on the degree to which teachers experience their work as a calling. The theory of callings holds that individuals who experience a calling perceive their work as a vehicle for fulfilling a transcendent purpose, as fundamentally tied to their sense of identity and destiny, and as an expression of their deepest values and commitments (Dik et al., 2012; Dobrow & Tosti-Kharas, 2011). For such individuals, the personal authorship of professional work is not merely a source of instrumental satisfaction but is constitutive of why their work matters (Thompson & Bunderson, 2019).

Specifically, we argue that teachers with stronger callings have more profoundly invested their sense of meaning and identity in the belief that their personal effort is what makes their teaching valuable. When AI disrupts the causal narrative connecting personal effort to meaningful outcomes, this disruption is more psychologically consequential for high-calling teachers, because the stakes of personal authorship are higher for them (Shen & Guo, 2024). Their ownership of the work product is not simply a matter of task engagement; it is a matter of vocational integrity. This prediction is consistent with identity-threat research showing that threats to central role identities produce stronger psychological responses than threats to peripheral ones (Stets & Burke, 2000), and with research on the dark side of calling showing that intense occupational identification increases vulnerability to burnout and loss of meaning when the conditions of meaningful work are undermined (Duffy et al., 2018).

In contrast, teachers low in calling tend to experience teaching more as an occupation that provides external rewards (e.g., salary, job security) than as an expression of their core identity (Duffy et al., 2018). They may therefore appraise AI involvement more instrumentally, as a way to reduce workload and increase efficiency. This does not mean that AI leaves their ownership unaffected: the routes through which AI weakens ownership should operate for all teachers. However, because their professional self-concept is less closely tied

to personal authorship of teaching outputs, the same reduction in authorship should carry less weight for them. For teachers high in calling, by contrast, the link between personal effort and meaningful outcomes is central to their professional identity, so a reduction in personal authorship should be felt more strongly. In other words, we expect calling to amplify, rather than create, the negative effect of AI involvement on ownership.

Taken together, we therefore predict that calling amplifies the negative effect of AI involvement on psychological ownership, and that this moderated effect propagates through to the downstream outcomes tested in both studies.

H4. *Calling will moderate the negative relationship between AI involvement and psychological ownership, such that the negative effect of AI involvement on psychological ownership will be stronger for teachers with higher levels of calling than for those with lower levels of calling (Study 1 and Study 2).*

2.6. Moderated Mediation: The Conditional Indirect Effects

The theoretical arguments above imply that the indirect effects of AI involvement on psychological well-being outcomes are not uniform but conditional: they are stronger for teachers with higher callings. This pattern constitutes a moderated mediation hypothesis, in which calling moderates the first stage of the mediation chain (AI involvement to psychological ownership), thereby producing differential indirect effects on the downstream outcomes.

In Study 1, the prediction is that the indirect effect of experimentally manipulated AI involvement on state pride through psychological ownership will be significantly stronger for teachers high in calling than for teachers low in calling. Because calling is measured as a pre-experimental trait and the AI manipulation is randomly assigned, this hypothesis is tested as a moderated experimental mediation, providing causal evidence for the conditional effect of the manipulation on ownership.

In Study 2, the parallel prediction is that the indirect effect of habitual AI involvement on work meaningfulness through psychological ownership will be stronger for teachers higher in calling. AI involvement and calling were measured one month before ownership and meaningfulness. This temporal separation reduces common method bias and ensures that the predictor and moderator were measured before the mediator and outcome. However, because ownership and meaningfulness were measured at the same time point, the mediation test is correlational and cannot rule out reverse causation.

H5a. *Calling will moderate the indirect effect of AI involvement on state pride through psychological ownership (Study 1), such that the negative indirect effect will be significantly stronger for teachers with higher calling than for those with lower calling.*

H5b. *Calling will moderate the indirect effect of habitual AI involvement on work meaningfulness through psychological ownership (Study 2), such that the negative indirect effect will be significantly stronger for teachers with higher calling.*

3. Overview of Studies

To test our theoretical model (see Figure 1), we employed a two-study design that leverages the complementary strengths of experimental and time-lagged field methods. The two studies address distinct but theoretically connected research questions: Study 1 tests whether AI involvement causes immediate erosion of psychological ownership and its proximal emotional consequence, state pride; Study 2 tests whether habitual AI involvement in teachers' everyday work is associated with lower ownership and, through it, a lower percep-

tion that teaching is meaningful. The allocation of outcome variables across the two studies reflects a principle of methodological matching rather than measurement impossibility. Although work meaningfulness could in principle be measured in an experimental context, single-episode laboratory manipulations may be unlikely to produce detectable changes in a work-wide perception that is assumed to change slowly (Steger et al., 2012; Podsakoff et al., 2003); any observed effect would be small, fragile, and difficult to distinguish from demand characteristics or transient mood contamination. Conversely, although state pride could be assessed in a time-lagged survey by asking participants to recall recent task-level emotions, such retrospective measurement would sacrifice the precision and causal clarity that distinguish state measures from trait measures (Robinson & Clore, 2002). The present design instead capitalizes on the comparative advantages of each methodology: the experiment provides causal evidence that revising an AI-generated draft, compared with independent creation, lowers ownership and pride, while the time-lagged survey examines whether the same pattern holds for habitual AI involvement and work-wide meaningfulness in teachers' actual practice. Together, the two studies test whether the pattern linking AI involvement to lower ownership and lower psychological rewards holds across two levels and two distinct methodological traditions. The detailed scales in both studies are presented in Appendix B.

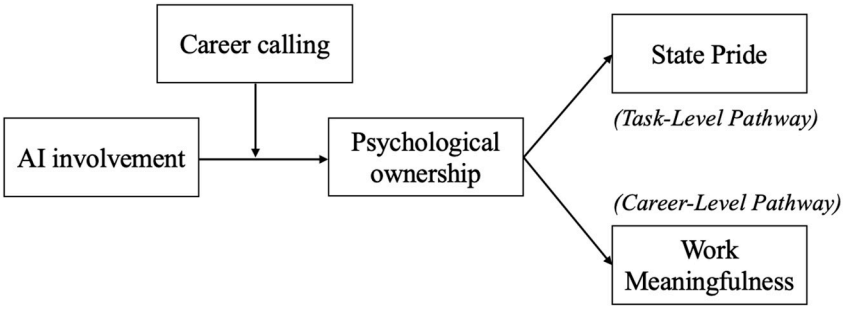


Figure 1. The hypothesized model.

Study 1 is a between-subjects experiment in which in-service teachers are randomly assigned to one of two conditions varying in the degree to which AI is involved in a classroom-activity design task: No-AI involvement (control), or AI-assisted completion. Calling was measured before the manipulation. Study 1 directly tests H1 (AI involvement predicts lower psychological ownership), H2 (psychological ownership mediates the AI-pride relationship), H4 (calling moderates the AI-psychological ownership association), and H5a (moderated mediation at the task level).

Study 2 is a two-wave time-lagged survey administered to a separate, independent sample of teachers in one public university in China. Participants completed the first survey (Time 1) measuring habitual AI involvement in teaching, calling, and demographic controls, and returned one month later for the second survey (Time 2) measuring psychological ownership and work meaningfulness. The one-month interval was selected to separate the measurement of the predictor and moderator from that of the mediator and outcome, which reduces common method bias (Podsakoff et al., 2003), while limiting attrition. Because ownership and meaningfulness were measured only at Time 2, the design establishes the temporal order of measurement but does not capture change in these variables, providing no evidence on whether work meaningfulness is stable over time; therefore, it fails to establish causality.

Crucially, the two studies use independent samples drawn from different educational institutions, ensuring that the results are not contaminated by within-person carry-over effects and that any conceptual replication across studies constitutes genuine convergent evidence rather than an artifact of sample overlap. In this vein, the generalizability of

our research findings can also be increased. In addition, all measurement scales originally developed in English were adapted into simplified Chinese following Brislin's (1980) translation-back-translation procedure. Specifically, two bilingual educational-psychology researchers independently forward-translated items into Chinese; a separate bilingual expert blind to original scales performed back-translation. Conceptual equivalence between original and back-translated items was examined, with minor wording adjustments resolved via team discussion. The draft questionnaire was further evaluated by subject-matter experts and piloted among a small group of in-service teachers to enhance contextual fit for Chinese teachers.

4. Study 1

The purpose of Study 1 is to test the psychological consequences of revising an AI-generated draft, compared with independent creation in teachers' creative instructional work. Specifically, we examined whether collaborating with AI during a creative teaching task would reduce teachers' psychological ownership over the resulting instructional product and subsequently diminish their state pride. In addition, we investigated whether teachers' calling moderated these effects.

Drawing on psychological ownership theory, we argue that creative teaching tasks are identity-relevant and professionally meaningful for teachers. When instructional materials are independently created, teachers are more likely to perceive the resulting products as personally authored and reflective of their own professional expertise. In contrast, when AI substantially contributes to the creative process, teachers may experience reduced feelings of ownership over the outcome, thereby weakening their pride in the completed work.

To test these predictions, we conducted a between-subject experiment where high school teachers were randomly assigned to either complete a classroom activity design task independently or complete the same task with AI assistance. Following task completion, participants reported their psychological ownership and state pride regarding the teaching product they had created. We also examined whether teachers with stronger career calling would be more psychologically affected by AI involvement.

4.1. Participants and Procedure of Study 1

Participants were high school teachers recruited from an educational ethics training program organized for in-service educators. One of the authors was the organizer of the training program, which focused on ethical literacy cultivation in educational settings. Upon completion of the program, teachers were invited to voluntarily participate in an additional research study concerning instructional design and teaching experiences. Participation was entirely voluntary, and teachers were informed that their responses would remain anonymous and confidential. No performance evaluation or institutional consequences were associated with participation. Participants received written information about the study purpose, task, and voluntary participation, with assurances that refusal would have no professional consequences. Written informed consent was obtained, and participants were informed of their right to withdraw at any time. All data were anonymized and used solely for research. Prior to the experiment, participants completed a brief questionnaire assessing demographic characteristics and career calling.

Participants were randomly assigned to one of two experimental conditions: an independent creation condition (i.e., No-AI) or an AI-assisted condition (i.e., AI-Assisted). In both conditions, participants were asked to complete a creative instructional task: a classroom activity lasting about 20 min. After completing the task, participants completed a post-task questionnaire measuring psychological ownership, state pride, manipulation

check items, and control variables. At the conclusion of the study, participants were debriefed regarding the purpose of the experiment.

4.2. Experimental Design of Study 1

Study 1 employed a two-condition between-subject experimental design manipulating the mode of task completion during a creative instructional activity. Participants were randomly assigned to one of two conditions. In the independent creation condition (i.e., No-AI), participants independently completed a classroom activity design task based solely on their own professional expertise and teaching experience. No AI-generated materials or technological assistance were provided. In the AI-assisted condition (i.e., AI-Assisted), participants completed the same classroom activity design task with the assistance of an AI-generated instructional draft. Participants were provided with a partially completed instructional framework generated by AI and were instructed to substantially revise, adapt, and personalize the material to produce a final classroom activity plan.

The manipulation was designed to vary the degree of AI involvement while holding constant task duration, task objectives, and instructional context. The two versions of the booklet (No-AI and AI-Assisted) were shuffled into a random sequence before the session and then handed out in seating order, so that each participant's condition was determined by the random sequence rather than by seating position. Participants could not see which version they would receive before opening the booklet. The task was completed with paper and pencil under the supervision of research assistants, who ensured that participants in the No-AI condition did not use AI tools or other devices. Despite random allocation, chance imbalances emerged between the two groups regarding age, educational level, and calling, which is not uncommon in experimental designs with modest sample sizes ($N = 101$). To ensure that these pre-existing differences did not confound our primary findings, we included age, educational level, and calling as covariates in all subsequent analyses. The reported effects of AI involvement on psychological ownership and state pride remain significant after accounting for these covariates (see Appendix A).

We recruited 103 participants who confirmed that they would join this study voluntarily. We received 103 responses. After deleting the incomplete responses, we finally obtained 101 valid responses ($N = 50$ in No-AI control condition, and $N = 51$ in AI-Assisted condition). Specifically, among these participants, 40 were female (39.6%), and most (47.5%) held a bachelor's degree ($N = 48$). In terms of the teaching tenure, the average years of teaching were 4.99. With regard to the subject area, 27 (26.7%) taught Chinese language, 18 (17.8%) taught mathematics, 18 (17.8%) taught English, and 38 (37.6%) taught other subjects.

4.3. Measures of Study 1

Unless otherwise specified, all measures were assessed using a 7-Likert scale ranging from 1 = strongly disagree to 7 = strongly agree.

Psychological ownership was measured immediately after participants completed the classroom-activity design task (Brown et al., 2014). The scale with six items from Van Dyne and Pierce (2004) assessed the extent to which participants perceived the completed teaching product as personally theirs. Sample items included: "I feel this teaching product is mine" and "I feel a very high degree of personal ownership for this job." Cronbach's α is 0.89.

State pride was measured following task completion to capture participants' immediate emotional reactions toward the teaching product they created. We used the seven different feelings and emotions (i.e., accomplished, like I am achieving, confident, fulfilled, productive, like I have self-worth, and successful) from Tracy and Robins (2007), and asked participants to indicate the extent to which they felt proud of their completed instructional

descriptions at that moment. Responses were recorded on a 7-point Likert scale, ranging from 1 = not at all to 7 = extremely. Cronbach's α is 0.74.

Teachers' career calling was assessed prior to the experimental manipulation to avoid potential contamination from the task experience. The scale measured the extent to which participants viewed teaching as a personally meaningful and identity-relevant vocation (Dik et al., 2012). We used the Brief Calling Scale-Presence subscale (BCS-Presence; 2 items) to minimize pre-experimental measurement burden while providing adequate sensitivity to identify high- versus low-calling participants for the moderation analysis. A sample item is "I have a good understanding of my calling as it applies to my career." The Spearman–Brown reliability coefficient for this two-item scale was 0.97.

To rule out potential confounding effects, we controlled for several demographic and professional characteristics of the teachers, including gender, age, educational attainment, teaching tenure, and subject area. Specifically, age and teaching tenure have been associated with greater professional identification and organizational embeddedness (Van Dyne & Pierce, 2004); gender and educational level may influence technology acceptance and self-efficacy (Akram et al., 2022); and subject areas capture disciplinary norms that could independently affect teachers' perceived autonomy and competence (Chiu et al., 2024). Gender was coded with 1 = female and 2 = male. Age and teaching tenure were measured as continuous variables (in years). Educational attainment was classified into four categories: 1 = high school diploma or below, 2 = associate degree, 3 = bachelor's degree, and 4 = postgraduate degree. Subject area was coded into four distinct categories: 1 = Chinese language, 2 = mathematics, 3 = English, and 4 = other subjects.

4.4. Manipulation Check

A manipulation check was conducted to verify the effectiveness of the AI involvement manipulation. Participants completed a manipulation check consisting of three items from Cooper and Zmud (1990) (i.e., "I heavily rely on AI tools to complete my core workflow", "AI tools play a central role in my creative and analytical tasks (e.g., lesson planning, feedback writing)" and "A significant portion of my work outputs is informed or generated by AI"). A one-way ANOVA revealed that participants in the AI-Assisted condition reported significantly higher perceived AI task involvement (M = 4.62, SD = 1.23) than those in the low AI involvement condition (M = 1.86, SD = 0.63), $F(1,99) = 198.13$, $p < 0.001$, $\eta^2 = 0.67$. An independent samples t-test (corrected for unequal variances) confirmed this difference, $t(77.52) = -14.32$, $p < 0.001$, d = −2.80, indicating the manipulation was highly effective.

4.5. Results of Study 1

Table 1 presents the means, standard deviations, and zero-order correlations among all study variables.

Table 1. Means, standard deviations, and correlations (Study 1).

Variable	M	SD	1	2	3	4	5	6	7	8
1. Teaching tenure	4.99	3.22								
2. Age	33.49	7.54	0.430 **							
3. Education level	2.49	0.81	−0.179	−0.448 **						
4. Gender	1.60	0.49	−0.028	−0.031	−0.015					
5. Subject area	2.66	1.24	0.130	−0.098	0.516 **	0.025				
6. Experimental condition	0.50	0.50	−0.188	−0.361 **	0.401 **	−0.154	0.083			
7. Psychological ownership	3.37	1.00	0.056	0.116	−0.208 *	0.105	−0.053	−0.631 **		
8. Calling	3.72	1.42	0.084	0.047	−0.237 *	0.161	−0.106	−0.353 **	0.534 **	
9. State pride	3.10	0.75	−0.008	0.114	−0.244 *	−0.048	−0.173	−0.526 **	0.660 **	0.503 **

Note. $N = 101$. Experimental condition coded 0 = No-AI, 1 = AI-Assisted. Correlations are significant at $p < 0.05$ (two-tailed). * $p < 0.05$. ** $p < 0.01$.

To test H1 and H2, we first employed PROCESS Macro Model 4 with 5000 bootstrap samples and 95% percentile bootstrap confidence intervals, entering experimental condition (TEAM: 0 = No-AI, 1 = AI-Assisted) as the predictor, psychological ownership as the mediator, and state pride as the outcome. To test H4 and H5a, we subsequently employed PROCESS Macro Model 7 with the same bootstrap specifications, adding calling as a moderator of the relationship between AI involvement and psychological ownership. Tenure, age, education, gender, and subject area were entered as covariates in all equations. Table 2 shows the results of regression.

The overall model predicting psychological ownership was significant, $R^2 = 0.413$, $F(6, 94) = 11.02$, $p < 0.001$. Consistent with H1, experimental condition was a significant negative predictor of psychological ownership ($b = -1.359$, $SE = 0.180$, $t = -7.544$, $p < 0.001$, *95% CI* [−1.716, −1.001]), indicating that teachers in the AI-Assisted condition reported substantially lower psychological ownership over the task product than those in the No-AI condition. The effect size was large, Cohen's $d = 1.50$, *95% CI* [1.06, 1.94], indicating that AI-assisted teachers reported substantially lower psychological ownership than those in the No-AI condition.

Prior to testing mediation, we examined the total effect of experimental condition on state pride. AI-assisted teachers reported significantly lower state pride than No-AI teachers ($b = -0.869$, $SE = 0.152$, $t = -5.717$, $p < 0.001$, *95% CI* [−1.171, −0.567]), with a large effect size, Cohen's $d = 1.14$, *95% CI* [0.72, 1.55].

Table 2. Regression Results for Psychological Ownership and State Pride (Study 1).

Variable	Psychological Ownership								State Pride			
	Model 4 (H1 Test)				Model 7 (H4 & H5a Test)				—			
	b	***SE***	***t***	***95% CI***	***b***	***SE***	***t***	***95% CI***	***b***	***SE***	***t***	***95% CI***
Constant	5.960 ***	0.720	8.276	[4.531, 7.389]	2.709 *	1.090	2.484	[0.543, 4.874]	2.896 ***	0.666	4.347	[1.573, 4.218]
Experimental condition	−1.359 ***	0.180	−7.544	[−1.716, −1.001]	−0.219	0.480	−0.455	[−1.173, 0.735]	−0.320 *	0.161	−1.992	[−0.639, −0.001]
Psychological ownership	—	—	—	—	—	—	—	—	0.404 ***	0.073	5.570	[0.260, 0.548]
Calling	—	—	—	—	0.625 **	0.190	3.290	[0.248, 1.003]	—	—	—	—
Condition × Calling	—	—	—	—	−0.230 *	0.114	−2.019	[−0.457, −0.004]	—	—	—	—
Gender	−0.008	0.158	−0.053	[−0.322, 0.305]	−0.079	0.147	−0.538	[−0.371, 0.213]	−0.210	0.115	−1.821	[−0.438, 0.019]
Age	−0.010	0.013	−0.774	[−0.035, 0.015]	−0.004	0.012	−0.359	[−0.028, 0.019]	−0.002	0.009	−0.201	[−0.020, 0.017]
Education	0.056	0.131	0.428	[−0.203, 0.316]	0.098	0.122	0.803	[−0.145, 0.341]	−0.010	0.096	−0.104	[−0.200, 0.180]
Teaching tenure	−0.006	0.025	−0.224	[−0.055, 0.043]	−0.004	0.025	−0.151	[−0.054, 0.047]	−0.014	0.020	−0.736	[−0.053, 0.025]
Subject area	−0.013	0.079	−0.165	[−0.169, 0.143]	−0.020	0.070	−0.290	[−0.160, 0.119]	−0.068	0.055	−1.239	[−0.178, 0.041]
ΔR^2 for Condition × Calling (Model 7) = 0.020, $F(1, 92) = 4.075$, $p = 0.046$												
R^2	0.413				0.544				0.493			
F	$F(6, 94) = 11.02$, $p < 0.001$				$F(8, 92) = 13.72$, $p < 0.001$				$F(7, 93) = 12.93$, $p < 0.001$			

Note. $N = 101$. Experimental condition coded 0 = No-AI (control), 1 = AI-Assisted. Coefficients for the psychological ownership equation reflect the moderated mediation model including the Condition × Calling interaction term; the main effect of experimental condition represents the simple slope when Calling = 0 (outside the scale range) and should be interpreted via the conditional effects in Table 3. *95% CI* = 95% confidence interval. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

Table 3. Moderating Effects of Calling (Study 1).

Calling	*b*	*SE*	*t*	*p*	*95% CI*
Low levels of calling	−0.679	0.278	−2.439	0.017	[−1.232, −0.126]
Moderate	−1.139	0.168	−6.788	<0.001	[−1.472, −0.806]
High levels of calling	−1.369	0.206	−6.643	<0.001	[−1.779, −0.960]
Calling	Indirect effect	Boot *SE*	Boot *95% CI*		
			LL		*UL*
Low levels of calling	−0.274	0.141	−0.597		−0.054
Moderate	−0.460	0.147	−0.764		−0.203
High levels of calling	−0.553	0.167	−0.890		−0.245
Index of moderated mediation	−0.093	0.043	−0.175		−0.002

Note. $N = 101$. Experimental condition coded 0 = No-AI (control), 1 = AI-Assisted. Negative values of *b* indicate that teachers in the AI-Assisted condition reported lower psychological ownership than those in the No-AI condition. Indirect effects estimated using PROCESS Model 7 with 5000 bootstrap samples. Boot *95% CI* = percentile bootstrap 95% confidence interval; *LL* = lower limit; *UL* = upper limit. Confidence intervals that do not include zero indicate a statistically significant indirect effect.

The overall model predicting state pride was significant, $R^2 = 0.493$, $F(7, 93) = 12.93$, $p < 0.001$. Psychological ownership was a significant positive predictor of state pride ($b = 0.404$, $SE = 0.073$, $t = 5.570$, $p < 0.001$, *95% CI* [0.260, 0.548]), such that teachers with higher psychological ownership over the task product reported greater state pride following task completion. As shown in Table 3, the indirect effect of experimental condition on state pride through psychological ownership was significant and negative (Effect = −0.549, Boot *SE* = 0.173, Boot *95% CI* [−0.918, −0.252]). This finding is consistent with the proposed mechanism, though we acknowledge that the partial mediation suggests additional unmeasured pathways may also contribute to this relationship. The direct effect of experimental condition on state pride, while attenuated relative to the total effect, remained statistically significant after controlling for psychological ownership ($b = -0.320$, $SE = 0.161$, $t = -1.992$, $p = 0.049$, *95% CI* [−0.639, −0.001]). The direct effect corresponded to a small-to-medium effect size, Cohen's $d = 0.42$, *95% CI* [0.01, 0.83]. Taken together, these results support H2[1].

Introducing calling as a moderator of the relationship between AI involvement and psychological ownership improved model fit for the psychological ownership equation, $R^2 = 0.544$, $F(8, 92) = 13.72$, $p < 0.001$. Consistent with H4, the interaction between experimental condition and calling in predicting psychological ownership was statistically significant ($\Delta R^2 = 0.020$, $F(1, 92) = 4.075$, $p = 0.046$). As shown in Table 3, the conditional effect of experimental condition on psychological ownership was significant and negative at all three levels of calling examined. Among teachers low in calling, AI-Assisted teachers reported lower psychological ownership than No-AI teachers ($b = -0.679$, $SE = 0.278$, $t = -2.439$, $p = 0.017$, *95% CI* [−1.232, −0.126]). This negative effect strengthened among teachers moderate in calling ($b = -1.139$, $SE = 0.168$, $t = -6.788$, $p < 0.001$, *95% CI* [−1.472, −0.806]) and was largest among teachers high in calling ($b = -1.369$, $SE = 0.206$, $t = -6.643$, $p < 0.001$, *95% CI* [−1.779, −0.960]). Figure 2. Simple slopes depicting the moderating role of calling on the effect of experimental condition on psychological ownership (Study 1). Error bars omitted for clarity; values at each point represent group means. Simple slope for high calling (at 84th percentiles): $b = -1.37$, $p < 0.001$. Simple slope for low calling (at 16th percentiles): $b = -0.68$, $p = 0.017$.

The index of moderated mediation was statistically significant (Index = −0.093, Boot *SE* = 0.043, Boot *95% CI* [−0.175, −0.002]), confirming that calling moderated the indirect pathway from experimental condition to state pride through psychological ownership, in support of H5a. As presented in Table 3, the conditional indirect effects were significant and negative at all three levels of calling: at low calling (Effect = −0.274, Boot *SE* = 0.141, Boot *95% CI* [−0.597, −0.054]), moderate calling (Effect = −0.460, Boot *SE* = 0.147, Boot *95% CI* [−0.764, −0.203]), and high calling (Effect = −0.553, Boot *SE* = 0.167, Boot *95% CI* [−0.890,

−0.245]). The indirect effect through psychological ownership strengthened monotonically with increasing levels of calling, such that the affective cost of AI involvement, mediated by ownership erosion, was amplified among teachers most vocationally committed to their profession. These results provide support for H5a.

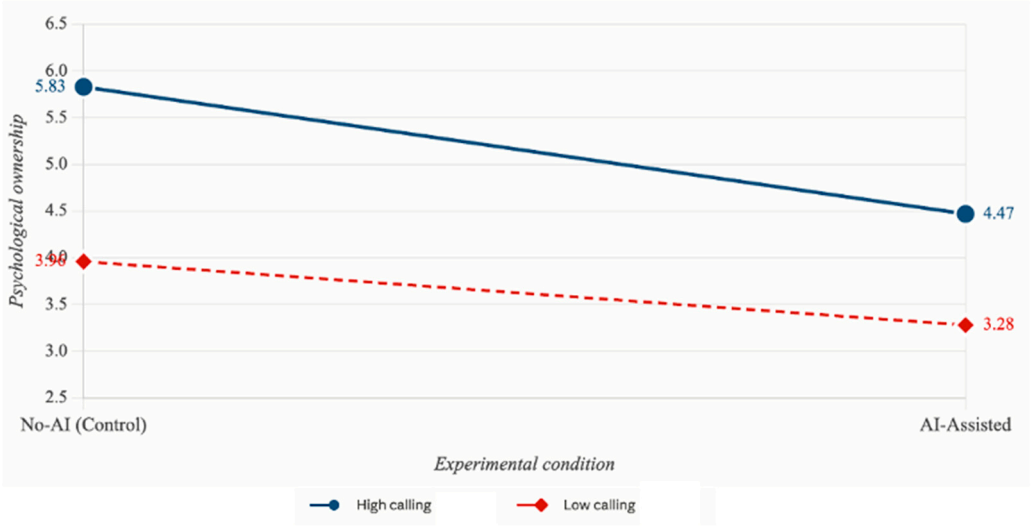


Figure 2. Simple slopes of experimental condition on psychological ownership at different levels of calling (Study 1).

It is important to note that our experimental manipulation involved both AI-generated content and a revision-based task structure. As such, the observed reduction in psychological ownership and state pride in the AI-Assisted condition may reflect the combined effect of engaging with AI-generated material and the inherently different cognitive and emotional demands of revising an existing draft, as opposed to generating content from scratch. We therefore interpret these findings as reflecting the psychological impact of an AI-assisted revision workflow, rather than isolating the effect of AI authorship alone.

4.6. Discussion of Study 1

Study 1 used a randomized experiment to test the task-level part of the model, and the results supported H1, H2, H4, and H5a. Teachers who revised an AI-generated draft reported lower psychological ownership than those who designed the activity independently, and lower ownership partially accounted for their lower state pride: the direct effect of condition on pride was attenuated but remained significant once ownership was controlled ($b = -0.32$, $p = 0.049$), suggesting that ownership is an important, though not the only, pathway. The effect of condition on ownership, and the indirect effect on pride, were stronger among teachers with stronger callings, consistent with the ironic vulnerability hypothesis.

However, Study 1 has two limitations that motivate Study 2. First, a single experimental task cannot speak to whether these effects generalize across task types or to habitual AI use, especially as the sample consisted exclusively of secondary-school teachers. Second, state pride is a task-specific emotion and cannot capture how AI use relates to teachers' perceptions of their work as a whole. Study 2 addresses both limitations with a two-wave field survey of an independent sample of university teachers, examining work meaningfulness as a work-wide outcome that complements state pride.

5. Study 2

The purpose of Study 2 was to extend the findings of Study 1 by examining the career-level correlates of AI involvement in teachers' creative instructional work in a real-world

educational context. Specifically, Study 2 investigated whether habitual AI involvement in creative teaching tasks would be associated with lower psychological ownership and, through it, lower university teachers' perception of their work as meaningful. In addition, we examined whether career calling moderated the pathway from AI involvement to psychological ownership. To establish the temporal order of measurement and reduce common method bias, we employed a two-wave time-lagged survey design among university teachers.

5.1. Participants and Procedure of Study 2

Participants were full-time faculty members recruited from a public university in China. Participation in the study was voluntary, and respondents were informed that their responses would remain confidential and would be used solely for academic research purposes. Data were collected using a two-wave time-lagged survey design to reduce common method concerns and strengthen temporal separation among study variables. Surveys were administered at two time points with an interval of approximately one month between waves. We selected a one-month interval to balance temporal precedence against participant attrition and recall bias. This duration is consistent with prior time-lagged studies on work attitudes and technology adoption (e.g., Tang et al., 2023), and it aligns with the typical frequency of teachers' instructional planning cycles. This interval was chosen to separate the measurement of the predictor and moderator from that of the mediator and outcome, not to assess the stability of work meaningfulness, which was measured only at Time 2.

At Time 1, we submitted 300 surveys to participants. They completed measures of AI involvement in creative teaching tasks, career calling. Participants also reported their demographic information, including gender, age, academic rank, teaching experience, and disciplinary background. We received 267 responses. One month later, at Time 2, participants completed measures of psychological ownership and meaningful work. We received 253 responses. We deleted some responses because their submissions were incomplete and/or they failed the attention check questions. After matching the responses at different time points, we finally obtained 231 valid responses. To assess potential attrition bias, we conducted attrition analyses by comparing participants who were included in the final matched sample with those who were not retained on Time 1 variables. To assess potential attrition bias, we conducted attrition analyses by comparing participants who were included in the final matched sample with those who were not retained on Time 1 variables. Chi-square tests were used for the categorical variables. Retained and non-retained participants did not differ significantly on age ($\chi^2(4) = 8.114$, $p = 0.087$), gender($\chi^2(1) = 0.368$, $p = 0.544$), educational level ($\chi^2(2) = 3.530$, $p = 0.171$), and subject ($\chi^2(5) = 7.997$, $p = 0.156$).

Among these responses, most (55.4% female) were female ($N = 128$). In terms of age distribution, 58 participants (25.1%) were under 25 years old (these participants were full-time junior lecturer-rank teaching faculty, not graduate students or postdoctoral researchers; in the Chinese higher-education system, master's-degree graduates may secure formal teaching positions shortly after graduation), 91 (39.4%) were aged between 26 and 35 years old, 50 (21.6%) were between 36 and 45 years old, 21 (9.1%) were between 46 and 55 years old, and 11 (4.8%) were 56 years old or above. Regarding their educational background, most (56.7%) held a doctoral degree ($N = 131$). With respect to their subject areas, 80 (34.6%) taught Humanities and Arts, 78 (33.8%) taught Social Sciences, 46 (19.9%) taught Natural Sciences, 15 (6.5%) taught Engineering and Technology, 8 (3.5%) taught Life Sciences and Medicine, and 4 (1.7%) taught other subjects. In terms of faculty rank, the sample consisted of 68 assistant professors/lecturers (29.4%), 132 associate professors (57.1%), 26 full professors (11.3%), and 5 participants (2.2%) holding other academic positions. Finally, regarding teaching tenure, 99 participants (42.9%) had less than 5 years

of experience, 117 (50.6%) had 6 to 10 years, and 15 (6.5%) had more than 10 years of teaching experience.

To ensure accurate matching across survey waves while preserving anonymity, participants generated a unique identification code based on predetermined personal cues (e.g., initials of their names and the last four of their phone numbers). Only participants who completed all two waves and were successfully matched were included in the final analyses. For the two-wave design, participants were informed in writing at Time 1 of the need to complete both surveys and that self-generated codes would be used solely for anonymous matching. Confidentiality, voluntary participation, and the right to withdraw without penalty were emphasized. Written consent was obtained at Time 1, with rights reaffirmed at Time 2. No incentives or penalties were applied.

5.2. Measures of Study 2

Unless otherwise specified, all measures were assessed using a 7-Likert scale ranging from 1 = strongly disagree to 7 = strongly agree.

AI involvement was assessed at Time 1 by measuring the extent to which teachers' involvement in AI tools in creative teaching-related work. Participants were instructed to reflect on teaching tasks such as lesson planning, instructional material preparation, classroom activity design, and feedback generation. We measured perceived AI involvement using a 5-item scale adapted from the technology infusion framework of Cooper and Zmud (1990) and the automation reliance scale of Jian et al. (2000). This adaptation aligns with recent high-impact investigations into human-AI interactions in organizational contexts (e.g., Tang et al., 2023). The items are "A significant portion of my daily work outputs is informed or generated by AI." "I heavily rely on AI tools to complete my core workflow." "I have delegated a substantial amount of my professional cognitive tasks to AI tools." "Without the assistance of AI tools, it would be difficult for me to complete my current workload." and "AI tools play a central role in my creative and analytical tasks." Cronbach's α is 0.96.

Calling was assessed at Time 1 to capture teachers' perception of teaching as meaningful and identity-relevant work. We used the full Calling and Vocation Questionnaire (CVQ-Presence subscale) with 12 items to improve measurement reliability in the larger survey sample. A sample item is "I have a sense that my career has been chosen for me." Cronbach's α is 0.94.

Psychological ownership was measured at Time 2 to capture the extent to which teachers felt that their teaching products genuinely belonged to them. The same scale as used in Study 1 was employed in Study 2 from Van Dyne and Pierce (2004), adapted to refer to respondents' overall teaching work. This measure targeted ownership of one's broader teaching work and professional outputs at the career level. Cronbach's α is 0.97.

Meaningful work was assessed at Time 2 using the Work and Meaning Inventory (WAMI). Employees rated the extent to which their work has a significant, worthwhile, and positive meaning. A sample item is "I have a good sense of what makes my job meaningful." Cronbach's α is 0.97.

Similar to Study 1, we controlled for a broader range of demographic and institutional factors to ensure the robustness of our findings: gender, age, educational attainment, subject area, faculty rank, and teaching tenure. Gender was treated as a categorical variable (1 = male, 2 = female). Age was measured using five ordinal categories: 1 = under 25 years old, 2 = 26–35 years old, 3 = 36–45 years old, 4 = 46–55 years old, and 5 = 56 years old or above. Educational attainment was categorized into three levels: 1 = bachelor's degree, 2 = master's degree, and 3 = doctoral degree. Subject area was classified into six categories: 1 = Humanities and Arts, 2 = Social Sciences, 3 = Natural Sciences, 4 = Engineering and

Technology, 5 = Life Sciences and Medicine, and 6 = others. We also controlled the faculty rank as it captures institutional status that could independently affect teachers' perceived autonomy and competence (Chiu et al., 2024). Faculty rank was divided into four levels: 1 = assistant professor/lecturer, 2 = associate professor, 3 = full professor, and 4 = others. Finally, teaching tenure was operationalized as an ordinal variable with three categories: 1 = less than 5 years, 2 = 6–10 years, and 3 = more than 10 years.

5.3. Results of Study 2

5.3.1. Preliminary Analyses

To evaluate the construct validity and distinctiveness of our focal variables (i.e., AI involvement, calling, psychological ownership, and work meaningfulness) in Study 2, we conducted a series of confirmatory factor analyses (CFAs) using AMOS prior to hypothesis testing.

The hypothesized four-factor baseline model, in which items for AI involvement, career calling, psychological ownership, and work meaningfulness loaded onto their respective latent factors, demonstrated a good fit to the data: $\chi^2 = 1254.13$, $df = 507$, CFI = 0.916, TLI = 0.907, RMSEA = 0.082, and SRMR = 0.077. To test for discriminant validity, we compared this baseline model against alternative models. Specifically, a three-factor model in which AI involvement and psychological ownership items loaded on a single factor fit significantly worse than the four-factor model ($\Delta\chi^2(3) = [X]$, $p < 0.001$), supporting their distinctiveness. Moreover, we compared this baseline model against a single-factor model where all items were forced to load onto a single general factor. The single-factor model yielded a very poor fit to the data: $\chi^2 = 5838.04$, $df = 527$, CFI = 0.373, TLI = 0.332, RMSEA = 0.221, and SRMR = 0.210, which was significantly worse than our hypothesized four-factor model. These results provide robust empirical support for the discriminant validity of our measures. Notably, AI involvement and psychological ownership are conceptually and empirically distinct: conceptually, AI involvement captures behavioral reliance on AI tools, whereas psychological ownership captures subjective feelings of personal possession; empirically, their zero-order correlation was moderate in magnitude ($r = -0.37$, $p < 0.01$), and the four-factor model fit significantly better than a model collapsing the two constructs into a single factor. No items overlap in wording or content across the two scales.

We also conducted Harman's single-factor test (Harman, 1976). The results indicated that the largest single factor accounted for only 36.21% of the total variance, which falls below the conventional 40% rule-of-thumb threshold. Taken together, these diagnostics confirm that common method bias is unlikely to distort the interpretation of our substantive findings.

5.3.2. Hypothesis Testing of Study 2

Means, standard deviations, reliabilities, and zero-order correlations among all study variables are presented in Table 4.

Consistent with the analytical strategy, we employed PROCESS Macro Model 4 to test H1 and H3, and PROCESS Macro Model 7 to test H4 and H5b, each with 5000 bootstrap samples and 95% percentile bootstrap confidence intervals. The results are shown in Table 5. Specifically, the overall model predicting psychological ownership was significant, $R^2 = 0.166$, $F(7, 223) = 6.34$, $p < 0.001$. Consistent with H1, AI involvement was a significant negative predictor of psychological ownership ($b = -0.331$, $SE = 0.054$, $t = -6.127$, $p < 0.001$, *95% CI* $[-0.438, -0.225]$), indicating that university teachers who reported higher habitual AI involvement in their teaching tasks at Time 1 reported lower psychological ownership over their teaching work at Time 2. Among the covariates, age emerged as a significant positive predictor of psychological ownership ($b = 0.230$, $SE = 0.094$, $t = 2.451$, $p = 0.015$,

95% CI [0.045, 0.414]), suggesting that older teachers tended to report stronger ownership over their work, net of AI involvement. Thus, H1 is supported.

Table 4. Means, standard deviations, and correlations (Study 2).

Variable	M	SD	1	2	3	4	5	6	7	8	9
1. Gender	1.55	0.498									
2. Age	2.29	1.087	−0.089								
3. Educational level	2.56	0.515	0.043	−0.042							
4. Subject	2.16	1.173	0.090	0.077	0.028						
5. Faculty rank	1.86	0.690	0.072	0.094	0.011	0.000					
6. Teaching tenure	1.64	0.602	0.022	0.175 **	0.013	0.013	−0.059				
7. AI involvement	3.91	1.83	0.029	0.070	−0.050	0.025	−0.051	0.067			
8. Psychological ownership	4.50	1.61	−0.030	0.121	0.024	0.056	0.030	−0.062	−0.370 **		
9. Calling	3.23	1.32	−0.067	0.010	−0.069	−0.100	−0.019	−0.002	0.409 **	−0.443 **	
10. Meaningful work	4.52	1.58	0.044	−0.043	0.134 *	0.054	−0.017	0.007	−0.247 **	0.553 **	−0.223 **

Note. $N = 231$. Correlations are significant at $p < 0.05$ (two-tailed). * $p < 0.05$. ** $p < 0.01$.

Table 5. Regression Results for Psychological Ownership and Work Meaningfulness (Study 2).

Variable	Psychological Ownership (T2)								Work Meaningfulness (T2)			
	Model 4 (H1 Test)				*Model 7 (H4 & H5b Test)*				—			
	b	*SE*	*t*	*95% CI*	*b*	*SE*	*t*	*95% CI*	*b*	*SE*	*t*	*95% CI*
Constant	5.375 ***	0.745	7.218	[3.907, 6.842]	3.523 ***	0.895	3.938	[1.760, 5.287]	1.238	0.725	1.707	[−0.192, 2.668]
AI involvement (T1)	−0.331 ***	0.054	−6.127	[−0.438, −0.225]	0.469 ***	0.133	3.533	[0.207, 0.730]	−0.031	0.051	−0.596	[−0.132, 0.071]
Psychological ownership (T2)	—	—	—	—	—	—	—	—	0.545 ***	0.059	9.280	[0.429, 0.661]
Calling (T1)	—	—	—	—	0.656 **	0.210	3.130	[0.243, 1.069]	—	—	—	—
AI involvement × Calling	—	—	—	—	−0.221 ***	0.040	−5.520	[−0.300, −0.142]	—	—	—	—
Gender	−0.027	0.200	−0.137	[−0.422, 0.367]	−0.232	0.179	−1.296	[−0.585, 0.121]	0.141	0.176	0.811	[−0.204, 0.489]
Age	0.230 *	0.094	2.451	[0.045, 0.414]	0.180 *	0.083	2.162	[0.016, 0.344]	−0.158	0.083	−1.901	[−0.322, 0.097]
Education	0.036	0.192	0.185	[−0.343, 0.414]	0.051	0.170	0.302	[−0.284, 0.387]	0.341 *	0.168	2.029	[0.010, 0.673]
Subject area	0.075	0.085	0.887	[−0.092, 0.242]	0.086	0.076	1.127	[−0.064, 0.235]	0.033	0.074	0.446	[−0.113, 0.180]
Faculty rank	−0.016	0.144	−0.108	[−0.300, 0.269]	−0.059	0.128	−0.458	[−0.311, 0.194]	−0.061	0.127	−0.479	[−0.310 0.189]
Teaching tenure	−0.174	0.167	−1.042	[−0.503, 0.155]	−0.139	0.148	−0.941	[−0.431, 0.153]	0.155	0.147	1.053	[−0.135, 0.444]
ΔR^2 for AI involvement × Calling (Model 7) = 0.089, $F(1, 221) = 30.47$, $p < 0.001$												
R^2	0.166				0.354				0.339			
F	$F(7, 223) = 6.34$, $p < 0.001$				$F(9, 221) = 13.48$, $p < 0.001$				$F(8, 222) = 14.23$, $p < 0.001$			

Note. $N = 231$. T1 = Time 1; T2 = Time 2. Indirect effect of AI involvement on work meaningfulness via psychological ownership (Model 4): Effect = −0.326, Boot *95% CI* [−0.443, −0.207]. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

The overall model predicting work meaningfulness was significant, $R^2 = 0.339$, $F(8, 222) = 14.23$, $p < 0.001$. Psychological ownership was a significant and substantively large positive predictor of work meaningfulness ($b = 0.545$, $SE = 0.059$, $t = 9.280$, $p < 0.001$, *95% CI* [0.429, 0.661]). The indirect effect of AI involvement on work meaningfulness through psychological ownership was significant and negative (Effect = −0.181, Boot $SE = 0.038$, Boot *95% CI* [−0.259, −0.110]), indicating a significant indirect association between AI involvement and work meaningfulness. Critically, the direct effect of AI involvement on work meaningfulness was non-significant after controlling for psychological ownership ($b = -0.031$, $SE = 0.051$, $t = -0.596$, $p = 0.552$, *95% CI* [−0.132, 0.071]), consistent with a pattern of full mediation. These findings support H3. Because ownership and meaningfulness were measured at the same time point, this indirect effect should be interpreted as a statistical association rather than as evidence of a causal sequence.

Introducing calling as a moderator of the relationship between AI involvement and psychological ownership substantially improved the explanatory power of the psychological ownership equation, $R^2 = 0.354$, $F(9, 221) = 13.48$, $p < 0.001$. Consistent with H4, the interaction between AI involvement and calling in predicting psychological ownership was highly significant ($\Delta R^2 = 0.089$, $F(1, 221) = 30.47$, $p < 0.001$), representing a large moderation effect. As shown in Table 6, the conditional effect of AI involvement on psychological ownership varied substantially across levels of calling. At a low level of calling (16th percentile, calling = 2.00), AI involvement was not significantly associated with psychological ownership ($b = 0.03$, $SE = 0.07$, $p = 0.685$). At moderate (50th percentile, calling = 3.00) and high (84th percentile, calling = 4.75) levels of calling, the association was significantly negative ($b = -0.19$, $SE = 0.05$, $p < 0.001$, and $b = -0.58$, $SE = 0.09$, $p < 0.001$, respectively; Figure 3). These results support H4.

The index of moderated mediation was significant (Index = −0.120, Boot $SE = 0.025$, Boot *95% CI* [−0.172, −0.075]), supporting H5b. The conditional indirect association was not significant at a low level of calling (Effect = 0.015, Boot *95% CI* [−0.063, 0.097]) but was significant and negative at moderate (Effect = −0.105, Boot *95% CI* [−0.173, −0.042]) and high levels of calling (Effect = −0.316, Boot *95% CI* [−0.428, −0.210]). Because ownership and work meaningfulness were measured at the same time point, these conditional indirect effects describe statistical associations rather than a causal sequence. Taken together, the results of Study 2 provide support for H3, H4, and H5b.

Table 6. Moderating Effects of Calling (Study 2).

Calling	*b*	*SE*	*t*	*p*	*95% CI*
Low levels of calling	0.027	0.067	0.407	0.685	[−0.105, 0.160]
Moderate	−0.193	0.053	−3.680	<0.001	[−0.297, −0.090]
High levels of calling	−0.580	0.086	−6.742	<0.001	[−0.749, −0.410]
Calling	**Indirect Effect**	**Boot *SE***	**Boot *95% CI***		
			LL	***UL***
Low levels of calling	0.015	0.040	−0.063	0.097
Moderate	−0.105	0.034	−0.173	−0.042
High levels of calling	−0.316	0.056	−0.428	−0.210
Index of moderated mediation	−0.120	0.025	−0.172	−0.075
Simple mediation (Model 4)	−0.181	0.038	−0.259	−0.111

Note. $N = 231$. Indirect effects estimated using PROCESS Model 7 with 5000 bootstrap samples. Boot *95% CI* = percentile bootstrap 95% confidence interval; *LL* = lower limit; *UL* = upper limit. Confidence intervals that do not include zero indicate a statistically significant indirect effect.

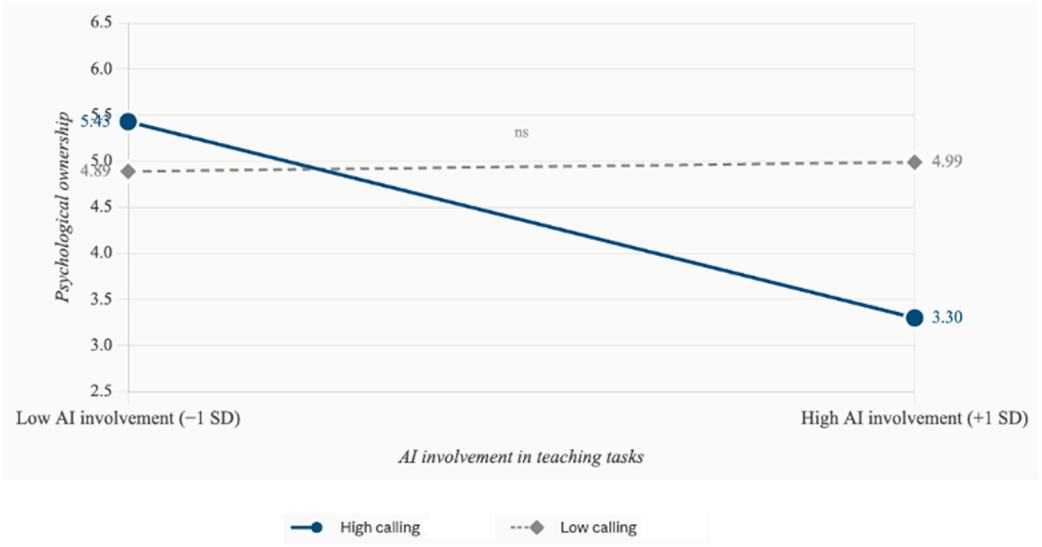


Figure 3. Simple slopes of AI involvement on psychological ownership at different levels of calling (Study 2).

To further illuminate the boundary condition of this interaction, we computed Johnson–Neyman significance regions to identify the range of calling scores for which the conditional effect of AI involvement on psychological ownership reached statistical significance. The critical threshold value of calling was 1.36, meaning that the negative conditional effect of AI involvement on psychological ownership was statistically significant for participants with calling scores above 1.36, and non-significant for those scoring below this value. Only 3.90% of participants in the present sample fell below this threshold. Notably, even at the low observed level of calling (+/−16th percentile, calling = 2.00), the conditional effect of AI involvement on psychological ownership was already non-significant ($b = 0.027$, $SE = 0.067$, $p = 0.685$). This Johnson–Neyman analysis corroborates the simple-slope results: the negative association between AI involvement and psychological ownership strengthens as teachers' career calling increases.

5.4. Discussion of Study 2

Study 2 extended the experimental findings of Study 1 to a naturalistic, career-level context, using a time-lagged field survey to examine whether habitual AI involvement in teaching tasks is associated with lower psychological ownership one month later and, through it, with lower university teachers' perceptions of meaningful work. Results supported all hypothesized effects and revealed an important boundary condition that sharpens the theoretical picture established in Study 1.

Consistent with H3, the association between AI involvement and work meaningfulness was indirect through psychological ownership; the direct association was not significant once ownership was taken into account. Ownership was strongly associated with work meaningfulness ($b = 0.55$), suggesting that the sense that one's professional outputs are one's own is closely tied to the experience of meaningful teaching work. Because ownership and meaningfulness were measured concurrently, however, the reverse direction—teachers who find their work more meaningful feeling greater ownership of it—cannot be ruled out. These results are consistent with, but do not establish, the proposition that AI involvement is costly because it weakens the link between personal effort and professional identity, rather than because it lowers output quality, which we did not measure.

Consistent with H4 and H5b, the negative indirect association between AI involvement and work meaningfulness through psychological ownership was stronger among teachers

with stronger callings. At lower levels of calling, neither the association between AI involvement and ownership nor the indirect association with meaningfulness was significant; because a non-significant effect is not evidence of no effect, this only indicates that these associations were weaker at lower levels of calling. The direction of moderation matched Study 1, although in Study 1 the effect of condition remained significant even at a low level of calling. The two studies thus show a pattern that is consistent in direction, although they differ in design, measures, and populations.

Contrary to Study 1, calling in Study 2 correlated positively with AI involvement ($r = 0.41$) but negatively with psychological ownership ($r = -0.44$) and work meaningfulness ($r = -0.22$). We verified the item coding and scoring of the CVQ, which was correct. One interpretation draws on the distinction between perceiving and living a calling (Duffy et al., 2018): the CVQ-Presence subscale captures the perception of a calling, and university faculty who perceive a strong teaching calling but face institutional pressures that limit their ability to enact it may experience lower meaning and ownership. The positive association with AI involvement may likewise reflect greater engagement with new teaching tools among more committed faculty. These interpretations are post hoc and warrant direct testing.

6. Discussion

AI tools are now woven into the daily fabric of teaching, yet little is known about how this integration affects teachers' own psychological experience. The present research addressed this gap by examining, across two methodologically complementary studies, how AI involvement in teaching tasks relates to the psychological ownership teachers hold over their professional outputs, and how ownership in turn relates to psychological rewards at two levels. Study 1 showed that revising an AI-generated draft in a classroom activity design task reduced teachers' psychological ownership of the resulting product and their state pride relative to independent creation, and that lower ownership statistically accounted for much of the effect on pride. Study 2 showed that habitual AI involvement at Time 1 was associated with lower psychological ownership one month later (at Time 2), which was in turn associated with lower perceived meaningfulness of work (at Time 2). In both studies, the association between AI involvement and ownership was stronger among teachers with stronger callings. We note that while this temporal ordering is consistent with our proposed mediation model, the correlational nature of Study 2 precludes definitive causal conclusions.

6.1. Theoretical Implications

A third contribution concerns the moderating role of calling. Contrary to the intuitive expectation that a strong calling would buffer teachers against the psychological costs of AI, the association between AI involvement and lower ownership was stronger among teachers with stronger callings in both studies. This pattern extends research on the potential dark side of calling (Duffy et al., 2018; C. Zhang et al., 2022) by suggesting that when the conditions for personal authorship are weakened, teachers whose professional identity is most invested in that authorship may be most affected. The pattern reflects a difference in magnitude rather than a cost confined to one group: in Study 1, revising an AI-generated draft lowered ownership even among teachers lower in calling, although the reduction was about half as large as among those higher in calling, whereas in Study 2 the association was not significant at lower levels of calling.

This extension has broader implications for psychological ownership theory. Morewedge et al. (2021) argued that technological change represents one of the most significant contemporary forces reshaping ownership experiences, yet their analysis focused primarily on

consumer contexts. The present research provides organizational-psychological evidence that these effects may extend to professional creative work, at least in the teaching tasks examined here, and that this disruption is psychologically costly in ways that go beyond consumer dissatisfaction. As AI becomes capable of producing professional outputs of increasing quality, the question of whether the outputs one submits feel genuinely mine may become one of the most psychologically consequential features of knowledge work (Watkins et al., 2023).

A second contribution is the dual-level framework, which distinguishes task-level costs, such as reduced pride in a specific product, from career-level costs, such as lower perceived meaningfulness of one's work as a whole. Previous research on AI and educational workers has typically examined a single outcome, such as performance or general job attitudes. Our results are consistent with the proposition that task-level outcomes respond to a single instance of AI involvement, whereas work-wide outcomes are associated with habitual AI involvement. Because we neither measured work meaningfulness in the experiment nor tracked change over time, however, this proposition remains to be tested. If it holds, single-episode experiments may underestimate effects on work-wide outcomes, and surveys of general AI use may miss task-specific emotional responses; studies that combine both levels would therefore give a more complete picture.

A further theoretical contribution concerns the moderating role of calling. We hypothesized, against the intuitive prediction that strong callings would buffer teachers against psychological effects of AI, that high-calling teachers would be most vulnerable to ownership erosion and its consequences. Our results support this prediction. This finding extends the emerging literature on calling's potential dark side (Duffy et al., 2018; C. Zhang et al., 2022) by suggesting a possible mechanism; that is, when the conditions of meaningful personal authorship that callings require are structurally disrupted—as AI involvement does—teachers whose occupational identity is most deeply invested in that authorship show the largest reductions in ownership. In addition, the moderation pattern indicates that the costs of AI involvement differ in magnitude across teachers rather than being confined to a subgroup. In Study 1, revising an AI-generated draft reduced ownership even among teachers lower in calling, although the reduction was about half as large as among teachers higher in calling. In Study 2, the association between AI involvement and ownership was not significant at lower levels of calling (see the Johnson–Neyman results below). Taken together, calling appears to amplify the ownership costs of AI involvement, with the largest costs among teachers whose professional identity is most invested in personal authorship.

This finding has an important implication for how we theorize about callings in contemporary workplaces. The calling literature has long emphasized the psychological benefits of experiencing work as a vocation—greater persistence, resilience, and intrinsic motivation (Dik et al., 2012). These benefits are likely genuine, but they presuppose conditions under which personal effort can be straightforwardly connected to meaningful outcomes. AI involvement disrupts this presupposition. Our results therefore suggest that calling's protective effects may be context-conditional: callings are psychologically beneficial when they align with the structural conditions of the work environment, but may become a source of vulnerability when those conditions no longer permit the sense of personal authorship that callings require.

6.2. Practical Implications

The findings carry several concrete implications for educational institutions, teacher professional development programs, and AI developers. Specifically, for institutional leaders considering AI adoption policies, our results suggest that institutions should consider how AI is integrated into the creative core of teaching work. While AI tools may reduce workload and improve output quality, the present findings suggest that this efficiency gain

may come at a psychological cost that is not immediately visible in performance metrics: lower ownership of teachers' work and, potentially, a weaker sense that their professional contribution matters. Institutions that care about teacher retention and motivation, both of which are associated with work meaningfulness (Steger et al., 2012), should consider whether AI is being deployed in ways that preserve rather than displace the personally authored creative labor that anchors teachers' professional identity.

The moderating role of calling suggests that AI deployment policies should not be uniform across teachers. Teachers who entered the profession with a strong sense of vocation showed the strongest associations between AI involvement and lower ownership in their core creative tasks. Professional development programs might productively address this vulnerability by helping teachers articulate and protect the domains of professional work in which personal authorship is most central to their identity, and by developing frameworks for distinguishing AI as a genuine creative collaborator from AI as a replacement for their own intellectual contribution.

For AI developers and educational technology designers, our findings suggest a possible direction that requires empirical testing: interfaces that keep teachers' own input central to the final product. Drawing on related work (e.g., Fang et al., 2023), one possibility is a "scaffolded" design in which, for instance, teachers specify their own pedagogical objectives before a draft is generated, or are prompted to adapt key components of AI-generated content. We did not test such features, and whether they preserve ownership without offsetting the efficiency benefits of AI remains an open question for future intervention studies.

6.3. Limitations and Future Directions

Several limitations of the present research should be acknowledged. First, although both studies were conducted in different Chinese education contexts, it may raise questions about the cross-cultural generalizability of our findings. The educational culture in China emphasizes strong teacher professional identity and high intrinsic investment in student development (X. Li et al., 2023), which may have amplified the psychological ownership effects we observed. Future research should replicate these findings in Western educational contexts and in primary and secondary school settings, where the dynamics of AI adoption and professional identity may differ. Meanwhile, Chinese educational culture traditionally emphasizes strong teacher dignity and high intrinsic professional responsibility (Ying et al., 2024). In such a context, outsourcing core intellectual labor to AI may be perceived not merely as a time-saving strategy, but as a more profound threat to professional identity and vocational integrity than it might be in Western contexts. Future research should replicate these findings in diverse cultural settings to test this boundary condition.

Second, Study 2 used a two-wave time-lagged design in which AI involvement and calling were measured at Time 1, and psychological ownership and work meaningfulness were both measured at Time 2, one month later. This design establishes the temporal order of measurement and reduces common method bias, but it has three important limitations. (a) Our framework treats work meaningfulness as a relatively enduring, work-wide appraisal, drawing on prior conceptualizations (Steger et al., 2012). However, because work meaningfulness was measured only once, and only one month after the predictor, the present data provide no evidence on whether work meaningfulness is in fact stable, and a one-month time-lagged design is not sufficient to support such a characterization. The distinction between task-level and career-level outcomes in our framework, and our allocation of work meaningfulness to the field study, therefore rest on a theoretical assumption that the present research did not test. (b) Because ownership and meaningfulness were not measured at Time 1, we could not control for their baseline levels and cannot speak to change in these variables; the observed associations may reflect pre-existing between-person differ-

ences rather than any decline over the month. (c) Because ownership and meaningfulness were measured concurrently, their association is cross-sectional, and reverse causation (e.g., teachers who find their work more meaningful developing greater ownership of it) cannot be excluded. Our findings should therefore not be taken as evidence of stability, cumulative change, or progressive erosion. Future research should measure work meaningfulness and ownership repeatedly over longer periods (e.g., three or more waves across a semester or academic year), which would allow test–retest stability to be estimated and within-person change to be modeled with cross-lagged or latent change analyses.

Fourth, the sample size in Study 1 ($N = 101$), while sufficient to detect statistically significant effects, is relatively small for an experimental design. Although our results demonstrated robust effect sizes, future research should replicate these findings with larger, more diverse samples to ensure adequate statistical power and to enhance the generalizability of the causal conclusions across different educational contexts. In addition, although conditions were randomly allocated, chance imbalances emerged on several pre-manipulation characteristics, including calling, age, and educational level. While we statistically controlled for these variables in our primary models, future research should employ larger samples or stratified randomization to minimize baseline discrepancies. Although controlling for these variables did not change the conclusions, unmeasured differences between groups cannot be fully ruled out. In addition, participants in the AI-Assisted condition began from an existing draft, whereas those in the No-AI condition started from scratch. Our design therefore cannot disentangle whether the observed reductions in psychological ownership and state pride stem from the presence of AI-generated content, the psychological experience of revising pre-existing material, or the interaction of both factors. Future experimental designs should employ factorial manipulations (e.g., AI vs. human draft × revision vs. generation) to isolate these distinct effects. In addition, the original AI-generated draft and the record of how it was generated were not retained, which limits the reproducibility of the manipulation. Because participants' written products were not retained, we also could not assess whether output quality differed between conditions. Moreover, participants were recruited through a training program organized by one of the authors, which may have introduced demand effects despite anonymous responding.

Fifth, the mechanisms we invoked to explain the effects—reduced control, intimate knowledge and self-investment, and the frustration of competence and autonomy needs—were not measured. These processes therefore remain theoretical interpretations rather than tested mediators. Future research should measure them directly (e.g., need satisfaction and frustration scales; perceived control and effort investment in the task) to test the full proposed chain.

Finally, we measured AI involvement as a general construct spanning multiple teaching tasks. It is possible that the psychological effects of AI involvement are task-specific: teachers may experience greater ownership erosion when AI assists with tasks they consider central to their professional identity (e.g., crafting personalized student feedback) than when AI assists with more peripheral or administrative tasks. Future research should develop task-specific measures of AI involvement and examine whether the ownership-erosion effect is stronger for identity-central versus identity-peripheral teaching activities.

7. Conclusions

As generative AI becomes part of everyday educational work, understanding its psychological effects on teachers is increasingly important. Across two studies with Chinese teachers, we found that AI involvement was associated with lower psychological ownership of teaching work. In an experiment with secondary-school teachers, revising an AI-generated draft lowered ownership and, through it, state pride relative to independent

creation. In a time-lagged survey of university faculty, self-reported AI involvement predicted lower ownership one month later, which in turn was associated with lower work meaningfulness. These associations were stronger among teachers with stronger callings. These findings do not imply that AI has no place in teaching; they suggest that its introduction calls for attention not only to what AI produces but also to teachers' sense of personal authorship. Whether these patterns generalize to other forms of AI assistance, other tasks, longer time frames, and other cultural and educational contexts, and whether design or training interventions can preserve ownership, remain questions for future research.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee in Weinan Normal University (Approval No. IRB 315E194; date of approval: 7 January 2025).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author due to participant privacy and ethical constraints.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A. Manipulation Materials

The task was completed on site with paper and pencil. Research assistants supervised the session to ensure that participants in the No-AI condition did not use AI tools or electronic devices. Participants' written products were not retained.

Participants in both experimental conditions completed the same instructional design task but received different instructions regarding the use of AI.

Independent Creation Condition (i.e., No-AI)

Participants assigned to the independent creation condition received the following instructions:

Please design a 20 min classroom activity for high school students to help them better understand a specific concept while increasing classroom engagement and participation.

Please complete this instructional activity independently based on your own teaching experience and professional expertise. During this task, please do not use any AI tools or external technological assistance.

You will have 20 min to complete the activity design.

No supporting instructional materials beyond the task prompt were provided.

AI-Assisted Condition (i.e., AI-Assisted)

Participants assigned to the AI-assisted condition received the following instructions:

Below is an AI-generated draft of a classroom activity designed for high school students. Please review the draft and substantially revise, adapt, and improve it based on your own teaching experience and professional judgment.

You are encouraged to personalize the activity, adjust instructional steps, improve student engagement strategies, and refine the design to make it suitable for your own classroom context.

Your goal is to create a classroom activity plan that you would realistically use in your own teaching.

You will have 20 min to complete the activity design.

Participants in this condition received a printed AI-generated draft of a classroom activity, which contained preliminary learning objectives and a basic activity outline, while the activity steps and engagement strategies were left incomplete for participants to develop. The draft was generated by the research team using a generative AI tool before data collection, and was not edited by the researchers. Because the original electronic file and generation record were not retained, the full text of the draft, the specific tool version, and the prompt cannot be reported.

To maintain meaningful teacher involvement and minimize passive copying, participants were explicitly instructed to personalize and substantially modify the AI-generated draft.

All the participants in both conditions were asked to create a 20 min instructional activity for high school students aimed at helping students understand a specific concept while promoting classroom engagement and active participation. To enhance ecological validity, the task was framed as a realistic teaching scenario commonly encountered by secondary school teachers.

Participants were instructed to design an activity that included a clear instructional objective, a sequence of classroom activities or learning steps, strategies to encourage student engagement and participation, and expected learning outcomes.

To standardize task difficulty across participants, all teachers received the same teaching scenario and instructional topic. The task was intentionally selected because it represents a creative, identity-relevant component of teachers' work in which professional expertise and personal pedagogical style are highly salient.

The task duration was fixed at 20 min for both experimental conditions to ensure comparability in time investment and reduce potential confounding effects related to effort expenditure.

Appendix B. Measurements

AI involvement

1. I heavily rely on AI tools to complete my core workflow.
2. AI tools play a central role in my creative and analytical tasks (e.g., lesson planning, feedback writing).
3. A significant portion of my daily work outputs is informed or generated by AI.
4. I have delegated a substantial amount of my professional cognitive tasks to AI tools.
5. Without the assistance of AI tools, it would be difficult for me to complete my current workload.

Psychological ownership (Study 1)

1. I sense that this teaching outcome is mine.
2. I feel a very high degree of personal ownership for this teaching product.
3. I sense that this is my work.
4. I feel a strong sense of belonging toward the effort I put into this task.
5. I would willingly say to others that this outcome is mine.
6. This teaching product reflects my personal ideas and professional judgment.
7. Completing this task made me feel it was my own creation.

Psychological ownership (Study 2)

1. I sense that this work is mine.
2. I feel a very high degree of personal ownership for this work.
3. I sense that this is my work.
4. I feel a strong sense of belonging toward the effort I invest in my teaching.
5. I would willingly say to others that my teaching work is mine.
6. My teaching work reflects my personal ideas and professional judgment.

7. My teaching work is the product of my own effort and expertise.

Career calling (Study 1)

1. I have a calling to a particular kind of work.
2. I have a good understanding of my calling as it applies to my career.

Career calling (Study 2)

1. I am passionate about being a teacher.
2. I enjoy my work as a teacher more than anything else.
3. Being a teacher gives me immense personal satisfaction.
4. I would sacrifice everything to be a teacher.
5. The first thing I often think about when I describe myself to others is that I'm a teacher.
6. I would continue being a teacher even in the face of severe obstacles.
7. I know that being a teacher—either professionally or as an educator—will always be part of my life.
8. I feel a sense of destiny about being a teacher.
9. My work as a teacher is always in my mind in some way.
10. Even when not engaged in teaching-related duties, I often think about my work as a teacher.
11. My existence would be much less meaningful without my involvement in teaching.
12. Being a teacher is a deeply moving and gratifying experience for me.

Meaningful work

1. I have found a meaningful career.
2. I understand how my work contributes to my life's meaning.
3. I have a good sense of what makes my work meaningful.
4. I have discovered work that has a satisfying purpose.
5. I view my work as contributing to my personal growth.
6. My work helps me better understand myself.
7. My work helps me make sense of the world around me.
8. My work really makes difference to the world.
9. I know my work makes a positive difference in the world.
10. The work I do serves a greater purpose.

Pride

1. I feel accomplished.
2. I feel like I am achieving.
3. I feel confident.
4. I feel fulfilled.
5. I feel productive.
6. I feel like I have self-worth.
7. I feel successful.

Note

[1] To account for baseline imbalance between experimental groups, we conducted a supplementary simple-mediation analysis entering pre-experimental calling together with demographic variables as covariates. Controlling for these variables, experimental condition negatively predicted psychological ownership ($b = -1.127$, $SE = 0.171$, $t = -6.61$, $p < 0.001$), and psychological ownership positively predicted state pride ($b = 0.315$, $SE = 0.078$, $t = 4.03$, $p < 0.001$). The indirect effect was significant (Effect = −0.355, Boot $SE = 0.155$, Boot *95% CI* [−0.694, −0.097]), and the direct effect of experimental condition remained significant ($b = -0.332$, $SE = 0.156$, $t = -2.13$, $p = 0.036$), confirming partial mediation.

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