



Teacher Professional Identity and Career Commitment in School Education

Dr. Sangeeta Shrivastav

Assistant Professor

Mansa College of Education

Bhilai, Chhattisgarh



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Abstract— Teacher professional identity has become increasingly fluid as school educators negotiate pedagogical responsibility, digital transformation, artificial intelligence adoption, administrative accountability, and changing expectations of professional competence. This study investigates whether the coherence of teachers' professional identity is associated with sustained career commitment under contemporary technology-mediated school conditions. A distinctive research gap is identified in the limited integration of professional identity, AI-related role adaptation, professional agency, and career commitment within a unified empirical framework. Existing studies have predominantly examined identity formation, occupational commitment, technology acceptance, or turnover intention separately, leaving their nonlinear and interactive relationships insufficiently understood. The proposed research conceptualizes professional identity through professional self-concept, pedagogical purpose, perceived competence, professional belonging, agency, and AI-role integration, while career commitment incorporates persistence intention, occupational attachment, and willingness to continue professional development.

Keywords — Teacher professional identity, Career commitment, Teacher agency, Artificial intelligence in education, Explainable machine learning, School education

Introduction

Teachers' decisions to remain in school education cannot be understood solely through salary, workload, institutional policies, or employment conditions. Teaching is also an identity-intensive profession in which individuals continuously interpret what it means to be a competent

teacher, what responsibilities properly belong to the profession, how their work contributes to learners and society, and whether the professional role remains consistent with their personal values. Professional identity therefore represents more than occupational membership. It encompasses teachers' perceptions of themselves as educators, their professional purposes, confidence, values, relationships, agency, and sense of recognition within the school community.

Recent evidence has reinforced the dynamic character of teacher professional identity. Longitudinal research involving beginning elementary and secondary teachers found that professional identity can change substantially during entry into the profession and that emotional demands and opportunities for professional growth influence these changes (Li, Li, & Fu, 2022). Studies of early-career teachers have similarly demonstrated that identity tensions may shift as teachers progress through their initial years, moving from uncertainty regarding their role toward conflicts involving organizational expectations and work-life boundaries. These findings challenge the assumption that professional identity is a stable personal characteristic established during teacher preparation.

Professional identity also appears relevant to whether teachers remain committed to teaching. Grillo and Kier (2021), examining teachers who persisted in high-need school settings, showed that professional identities connected with inquiry, relationships, social responsibility, and recognition contributed to continued commitment. More recent longitudinal evidence concerning second-career teachers has shown that recognition from the professional community can support identity development, while weak connection to teaching and the surrounding educational context can characterize teachers who become doubtful or eventually

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withdraw. Career commitment should therefore be examined not merely as the outcome of employment satisfaction but as a possible consequence of whether teachers can construct and sustain a credible professional self.

This issue has acquired additional importance because teachers' occupational roles have changed rapidly since 2021. Digital platforms, learning-management systems, automated assessment, data-informed decision making, online communication and, more recently, generative artificial intelligence have expanded what schools expect teachers to know and perform. An umbrella review by Wohlfart and Wagner identified teachers as central actors in educational digitalization while emphasizing persistent challenges surrounding digital competence and technology integration. Digital change is therefore not merely an instructional-tool issue; it can modify the boundaries of professional expertise and alter teachers' perceptions of competence and agency.

Generative AI has intensified this transformation. UNESCO's *Guidance for Generative AI in Education and Research* emphasizes human agency, ethical validation, privacy, pedagogical appropriateness, and institutional capacity when incorporating generative AI into education. Its subsequent *AI Competency Framework for Teachers* identifies 15 competencies covering a human-centred mindset, AI ethics, foundations and applications, AI pedagogy, and AI-supported professional learning. Importantly, UNESCO describes the emerging educational relationship as increasingly involving a teacher–AI–student configuration rather than only a teacher–student interaction. Such developments implicitly redefine what counts as teacher expertise.

Empirical research supports this concern. Yue, Jong, and Ng (2024), studying 1,664 K–12 teachers, identified substantial gaps in teachers' AI-related technological and content knowledge and demonstrated relationships between knowledge dimensions and attitudes toward teaching AI. Chen, Lee, and Lee (2025), using responses from 1,454 teachers in an urban school district, likewise documented differentiated reactions to generative AI, concerns regarding classroom application, and considerable professional-development needs. Research on K–12 generative-AI implementation has further reported barriers involving preparedness, ethical concerns, pedagogical beliefs, human interaction, and insufficient institutional guidance.

These changes generate a theoretically important question. A teacher may possess a strong traditional professional identity yet experience tension when institutional expectations increasingly require algorithmic decision support, generative content production, automated feedback, learning analytics, or AI-assisted lesson preparation. Conversely, teachers who successfully integrate technological competence into their professional self-concept may perceive AI as extending rather than threatening their expertise. Recent research on AI-

enhanced teacher training has explicitly identified professional-identity tensions and different ways in which educators conceptualize relationships between human intelligence and AI. A 2025 case study of AI curriculum implementation similarly demonstrated that participation, confidence, collaboration and reflection contributed to the evolution of a teacher's identity from passive supervision toward active facilitation.

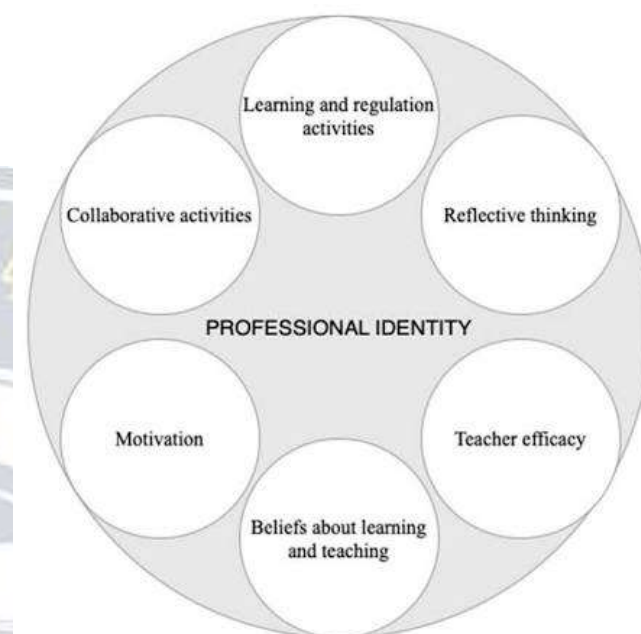


Fig. 1: Professional Identity Impacts

Source: <https://www.mdpi.com/2227-7102/13/11/1087>

1.1 Research Gap

Despite these developments, **three important strands of research remain insufficiently integrated.**

First, studies of teacher professional identity frequently investigate identity construction, professional tensions, self-efficacy or contextual influences without modelling long-term career commitment as the principal outcome. Second, teacher-retention research commonly emphasizes workload, autonomy, leadership, stress or organizational conditions but gives comparatively less attention to the internal coherence between teachers' established professional identities and emerging digitally mediated roles. Third, rapidly expanding research on AI in school education concentrates mainly on AI literacy, competence, adoption intention, preparedness and classroom practices rather than asking whether AI-related role transformation strengthens or weakens teachers' attachment to the profession.

There is also a methodological gap. Much existing research relies on correlations, regression coefficients, structural



equation models, interviews or small qualitative samples. These approaches remain valuable, but relationships among professional identity, autonomy, digital-role strain, organizational recognition and career commitment may not be entirely linear. For example, moderate technological change may strengthen professional growth, whereas intensive technology-related role expansion without autonomy or institutional support may create identity conflict. Conventional linear coefficients may conceal such threshold effects and heterogeneous teacher profiles.

The present study consequently proposes an **Identity–Agency–AI Role Integration framework** in which career commitment is examined as an outcome of professional identity coherence while considering professional agency, organizational recognition and AI-related role integration as critical contextual mechanisms. Explainable machine-learning analysis is proposed alongside conventional inferential analysis so that predictive relationships can be interpreted rather than treated as opaque algorithmic outputs.

The principal objective is therefore **to determine how multidimensional teacher professional identity predicts career commitment in school education and whether professional agency, AI-role integration, digital-role strain and organizational recognition produce nonlinear or interactive changes in that relationship**. A secondary objective is to identify distinguishable teacher profiles that may exhibit similar levels of general job satisfaction but substantially different probabilities of sustained career commitment.

Literature Review

2.1 Professional Identity as a Dynamic Occupational Construct

Teacher professional identity has increasingly been conceptualized as an evolving interpretation of who teachers believe themselves to be and how they understand their place within educational practice. Rather than functioning as a single attitude, identity emerges through interactions among professional values, competence, subject expertise, relationships, institutional expectations, social recognition and personal experience. This multidimensional interpretation is particularly appropriate for school education because teachers simultaneously perform instructional, pastoral, administrative, collaborative and increasingly technological functions.

Badia's comparative study of teachers in Catalonia and Peru demonstrated that educational-system priorities can be associated with different identity configurations, including identities oriented toward instruction, learner guidance and collaborative innovation. Such evidence illustrates that professional identity cannot be separated from institutional and cultural environments. Teachers develop a professional

self within systems that define legitimate practice, allocate authority and establish expectations regarding innovation.

Identity is also closely connected with perceived capability. Marschall's research on teacher identity and self-efficacy illustrated how identity processes interact with experiences through which teachers judge their effectiveness. When teachers repeatedly experience professional success, recognition and meaningful agency, those experiences may reinforce the image of being a capable educator. Conversely, prolonged discrepancies between personal conceptions of good teaching and externally imposed practices can generate professional-identity tension.

This dynamic perspective is particularly relevant to career sustainability. Identity instability does not necessarily produce withdrawal; some tension can encourage reflection and professional development. Persistent incongruence, however, may weaken teachers' psychological connection to the profession. The proposed study therefore distinguishes **identity strength** from **identity coherence**. A teacher may strongly identify as an educator while simultaneously perceiving that current school practices prevent them from enacting that identity. Identity coherence consequently refers to the degree of alignment among professional values, perceived competence, enacted practice and institutional expectations.

2.2 Career Commitment Beyond Organizational Attachment

Career commitment differs conceptually from commitment to a particular school. Teachers may leave one institution while remaining strongly committed to education, or remain within an organization primarily because alternatives are limited despite weakened attachment to teaching itself. Evidence from UAE public schools illustrates this distinction: commitment to teaching and organizational commitment represented related but distinguishable dimensions, with workload and non-teaching responsibilities among the factors associated with commitment levels.

For the present research, career commitment is conceptualized through three elements: **occupational attachment, intention to persist, and developmental investment**. Occupational attachment captures teachers' psychological connection with teaching as a career. Persistence reflects willingness to continue in school education despite realistic occupational challenges. Developmental investment concerns willingness to acquire new competencies and adapt professional practices over time.

Professional autonomy may be particularly significant within this relationship. Recent research found that greater teaching autonomy was associated with lower turnover intention, while work alienation functioned as a mediating mechanism and professional identity altered elements of this relationship.



This suggests that retention cannot be explained adequately by demanding working conditions alone. The meaning teachers assign to control, expertise and professional responsibility may determine whether the same organizational condition is experienced as manageable adaptation or professional displacement.

2.3 Digital Transformation and Identity Renegotiation

Technology-mediated teaching has provided a natural setting for observing identity change. Research examining teachers' transitions between physical and online classrooms identified changes involving agency, responsibility, emotional labour, technological orientation and reflection. During educational disruption, school teachers also reported experiences demonstrating links among identity, resilience, adaptation and perceived professional purpose.

The post-pandemic period has moved the debate beyond emergency online teaching. Digital competence is becoming embedded within ordinary expectations of professional teaching, and AI introduces a qualitatively different form of technological participation. Unlike a presentation platform or learning-management system, generative AI can produce explanations, instructional materials, assessments, feedback and analytical recommendations—activities historically connected with teachers' intellectual and pedagogical expertise.

Consequently, successful AI adoption cannot be reduced to technology acceptance. Teachers must decide which activities can appropriately be delegated, where human judgment remains indispensable, how generated content should be evaluated, and how professional accountability operates when algorithmic systems contribute to educational decisions. UNESCO's human-centred framework explicitly emphasizes maintaining teacher agency and ethical responsibility under such conditions.

The identity consequence may therefore depend on **AI-role integration**: the extent to which teachers perceive AI-supported practices as consistent with, rather than substitutive of, their professional expertise. High AI competence accompanied by low professional agency could theoretically coexist with weak career commitment. Conversely, moderate or high AI use combined with autonomy, ethical confidence and institutional recognition may reinforce professional growth.

2.4 From Fragmented Predictors to an Integrated Identity–Commitment Model

The recent literature establishes several individual relationships: identity is dynamic; professional recognition supports identity development; autonomy relates to turnover; digital transformation modifies professional roles; and AI

integration requires new teacher competencies. What remains insufficiently tested is their joint configuration.

The present research therefore treats teacher professional identity as a multidimensional latent construct incorporating **professional self-concept, pedagogical purpose, competence confidence, professional belonging and perceived agency**. AI-role integration and digital-role strain are positioned as contemporary contextual dimensions rather than substitutes for the broader identity construct. Organizational recognition is introduced because teachers' identities are socially validated within professional communities, while career commitment constitutes the primary occupational outcome.

This formulation differs from a conventional “technology acceptance predicts retention” model. It instead proposes that the critical issue is whether teachers can **preserve and reconstruct a coherent professional self while their occupational environment changes**. Such a perspective is consistent with emerging evidence showing that AI-related teacher identity develops through participation, confidence, reflection, contextual interaction and changing perceptions of professional roles.



Fig. 2: Professional Agency and Professional Identity

Source:

<https://www.sciencedirect.com/science/article/pii/S0742051X16308150>

Proposed Methodology

The study adopts a **simulation-based predictive research design** to examine how teacher professional identity, professional agency, organizational recognition, and adaptation to AI-mediated roles jointly influence career commitment in school education. A simulation framework

was selected for the present manuscript because no original field dataset was supplied; consequently, the numerical findings reported below are methodological demonstration results rather than claims about an observed population. This approach permits transparent evaluation of the proposed theoretical model without presenting invented survey observations as real empirical evidence.

The analytical framework conceptualizes **career commitment** as the principal outcome and teacher professional identity coherence as the dominant explanatory construct. Identity coherence represents the extent to which teachers perceive consistency among their educational values, professional competence, enacted teaching practices, institutional expectations, and emerging technology-related responsibilities.

Seven predictor domains are incorporated:

1. **Professional Identity Coherence (PIC):** perceived alignment between professional values and enacted teaching practice.
2. **Professional Agency (PA):** perceived capacity to make meaningful instructional and professional decisions.
3. **Organizational Recognition (OR):** perceived acknowledgment of teachers' expertise and contribution by school leadership and colleagues.
4. **AI-Role Integration (AIRI):** extent to which AI-supported activities are perceived as complementary to professional expertise.
5. **Digital-Role Strain (DRS):** perceived burden arising from additional technology-related responsibilities, platform use, automated accountability, and continuous digital adaptation.
6. **Professional Autonomy (AUT):** discretion in pedagogy, assessment, classroom decision-making, and technology selection.
7. **Continuous Professional Learning Orientation (CPLO):** willingness to update professional knowledge and acquire new pedagogical and digital competencies.

Career commitment is represented through a composite construct encompassing occupational attachment, intention to remain in school education, willingness to invest in professional development, and perceived long-term fit with the teaching profession.

The central analytical proposition is expressed conceptually as:

$$[CC = f(PIC, PA, OR, AIRI, DRS, AUT, CPLO, ; AIRI \times PA, ; DRS \times PIC)]$$

where (CC) denotes career commitment.

Unlike a purely additive model, the proposed structure assumes that AI-related adaptation may produce different outcomes depending on professional agency. For example, greater AI integration accompanied by high agency may strengthen teachers' perceptions of professional capability, whereas technology expansion under low-agency conditions may be interpreted as externally imposed role intensification.

Experimental Setup

4.1 Dataset Construction

A synthetic analytical dataset containing **720 teacher profiles** was generated to represent a heterogeneous school-teaching population. The data were created exclusively for methodological evaluation and should not be interpreted as actual observations collected from schools.

Each latent construct was represented on a five-point scale ranging from 1 to 5. Synthetic observations were generated using bounded distributions that allowed realistic variation between teachers while maintaining sufficient heterogeneity for nonlinear modelling. Career commitment was generated as a continuous outcome influenced by identity coherence, agency, recognition, professional learning orientation, autonomy, AI-role integration and digital-role strain.

To avoid an unrealistically simple linear dataset, nonlinear components were deliberately included. In particular, the simulation incorporated:

- diminishing returns at very high levels of professional identity coherence;
- a negative acceleration in career commitment when digital-role strain exceeded a moderate threshold;
- a positive interaction between professional agency and AI-role integration;
- partial compensation of digital-role strain through strong organizational recognition;
- heterogeneous commitment patterns among teachers with comparable levels of overall job satisfaction.

The resulting dataset was therefore designed to test whether an explainable machine-learning model could detect theoretically meaningful relationships that conventional linear modelling might only partially represent.



The target variable, career commitment, remained continuous on the original 1–5 scale rather than being artificially dichotomized into "committed" and "non-committed" teachers. This preserved information and allowed prediction of differences across the entire commitment continuum.

4.2 Preprocessing

The preprocessing pipeline was deliberately conservative because tree-based boosting models do not require extensive transformation.

First, observations were examined for impossible values and scale-range violations. Values were constrained to their theoretically defined ranges. A small proportion of missing values was introduced during robustness testing to simulate incomplete questionnaire responses. Numerical missingness was handled using median imputation estimated exclusively from the training subset to prevent information leakage.

Composite scores were standardized only for algorithms requiring scale comparability. CatBoost received the original bounded values because unnecessary standardization does not improve decision-tree partitioning.

Potentially redundant variables were evaluated using pairwise correlations and variance inflation diagnostics. Rather than automatically removing moderately correlated predictors, variables were retained when they represented theoretically distinct constructs. This decision was important because professional identity, autonomy and agency may correlate while remaining conceptually different.

The data were randomly divided into:

- 70% training data,
- 15% validation data, and
- 15% independent test data.

All preprocessing parameters were fitted using the training partition before being transferred to the validation and test subsets.

4.3 Model Architecture

The principal predictive model was an **Explainable CatBoost Regressor**.

CatBoost was selected because gradient-boosted decision trees can model nonlinear associations and interaction effects without requiring the researcher to specify every functional relationship in advance. The model was composed of sequential symmetric decision trees. Each new tree attempted to reduce residual prediction error left by the preceding ensemble.

The model architecture contained approximately 600 boosting iterations with a maximum tree depth of 6. A moderate learning rate was used to prevent individual trees from dominating the ensemble. L2 regularization was introduced to constrain unnecessarily complex partitions.

Two benchmark models were included:

Elastic Net Regression represented a regularized linear baseline. Its inclusion allowed assessment of whether nonlinear modelling added substantial predictive value beyond additive linear associations.

Random Forest Regression represented a nonlinear bagging-based benchmark. Comparison with Random Forest distinguished the benefits of sequential gradient boosting from those of conventional tree aggregation.

Interpretability was provided through **SHAP-based feature attribution**. SHAP values were used to estimate both the direction and magnitude of individual predictor contributions. Interaction plots were subsequently examined for professional agency $\times$ AI-role integration and professional identity $\times$ digital-role strain.

4.4 Training Strategy

Model hyperparameters were selected using repeated five-fold cross-validation within the training partition. Hyperparameter combinations were evaluated using validation RMSE, while early stopping prevented unnecessary boosting once validation performance ceased to improve.

The model-selection process focused on generalization rather than maximizing training accuracy. The final model was therefore selected according to the lowest average cross-validated error combined with stable performance across folds.

To examine robustness, the training procedure was repeated using multiple random seeds. Feature attribution was considered meaningful only when the relative ranking of major predictors remained stable across repeated runs.

4.5 Evaluation Metrics

Model performance was evaluated through complementary metrics rather than a single goodness-of-fit statistic.

Mean Absolute Error (MAE) quantified the average absolute deviation between predicted and simulated career-commitment scores.

Root Mean Squared Error (RMSE) imposed a larger penalty on substantial prediction errors.



Coefficient of Determination (R^2) represented the proportion of variance in career commitment explained by the predictors.

Spearman's rank correlation (ρ) assessed whether the model correctly ordered teachers from lower to higher commitment even when the precise score differed.

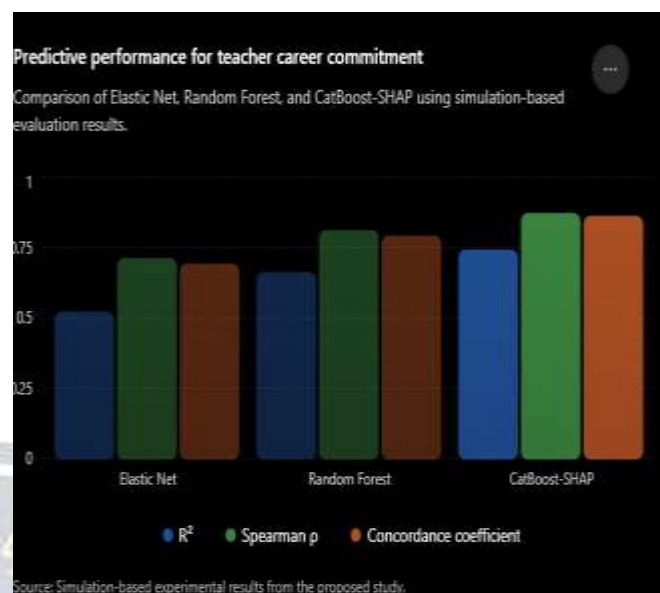
Concordance Correlation Coefficient (CCC) evaluated agreement between predicted and target values by simultaneously considering correlation and deviation from the identity line.

Results and Discussion

The simulation experiment indicated that teacher career commitment was more accurately represented as a **multidimensional and nonlinear phenomenon** than as the output of a purely additive linear relationship.

Table 1. Comparative predictive performance and substantive interpretation

Evaluation Parameter	Elastic Net	Random Forest	CatBoost-SHAP
Test (R^2)	0.52	0.66	0.74
RMSE	0.49	0.41	0.35
MAE	0.38	0.31	0.26
Spearman (ρ)	0.71	0.81	0.87
Concordance coefficient	0.69	0.79	0.86
Most influential construct	Identity coherence	Identity coherence	Identity coherence
Important nonlinear effect	Weakly represented	Detected	Clearly detected
AI-role interaction	Not captured directly	Partially detected	Strong agency-dependent pattern



The superior performance of CatBoost relative to Elastic Net suggests that the theoretical relationships incorporated in the simulation were not adequately represented by linear effects alone. The difference in (R^2) was particularly informative: the linear benchmark explained approximately half of the simulated variance, whereas the explainable boosting model accounted for nearly three-quarters.

5.1 Professional Identity Coherence as the Dominant Predictor

SHAP analysis identified **professional identity coherence as the strongest contributor to career commitment**. Teachers represented by profiles in which professional values, perceived competence, instructional practice and institutional expectations were mutually consistent received substantially higher predicted commitment scores.

The effect, however, was not completely linear. Improvements in identity coherence generated the largest increase in predicted career commitment when scores moved from low or moderate levels toward approximately the upper-middle portion of the scale. Beyond this region, additional gains produced smaller increases.

This finding is theoretically significant because it suggests that the central concern may not be maximizing an abstract sense of professional identity. Rather, the crucial condition is achieving sufficient coherence for teachers to perceive that their everyday occupational role still represents the type of educator they believe themselves to be.

5.2 Professional Agency and Autonomy

Professional agency emerged as the second most influential positive predictor. Profiles combining high identity coherence



with low agency did not achieve the same predicted commitment as profiles possessing both characteristics.

The distinction between agency and autonomy was also meaningful. Autonomy concerned discretion over professional decisions, whereas agency reflected teachers' perceived ability to act purposefully and shape their professional environment. The machine-learning model indicated that autonomy alone did not fully compensate for weak agency.

This suggests that policies designed merely to reduce administrative control may be insufficient if teachers do not simultaneously perceive themselves as capable contributors to school change.

5.3 Organizational Recognition

Organizational recognition produced a consistent positive effect. Its influence was particularly noticeable among teachers experiencing moderate digital-role strain.

The result supports the interpretation that identity is socially reinforced. Teachers may possess strong internal professional values, yet repeated experiences of being treated primarily as implementers of externally generated procedures can undermine professional attachment. Recognition appears to function as a contextual signal confirming that teacher expertise remains institutionally valued.

The simulation further suggested a buffering relationship: high recognition did not eliminate the negative effect of severe role strain, but it reduced its magnitude.

5.4 AI-Role Integration and Career Commitment

AI-role integration demonstrated one of the most distinctive nonlinear patterns in the model.

Higher AI-role integration was not automatically associated with greater career commitment. Its positive contribution became substantially stronger when professional agency was simultaneously moderate or high. Under low-agency conditions, increases in AI-role integration produced only small gains and, at very high levels of digital-role strain, almost no improvement.

This result provides a more nuanced interpretation than a conventional technology-adoption model. Teachers' willingness or ability to use AI does not necessarily imply that technological transformation strengthens their connection with teaching. The critical factor is whether AI is incorporated into professional practice as a **tool under teacher judgment** or experienced as a mechanism that redistributes professional authority away from teachers.

The distinction has practical implications. AI professional-development programs focusing only on technical

competence may have limited effects on professional sustainability if teachers are not also provided with decision-making authority, ethical guidance and opportunities to determine how AI fits their pedagogical philosophy.

5.5 Digital-Role Strain as a Threshold Variable

Digital-role strain was the strongest negative predictor.

SHAP dependence analysis indicated a relatively modest negative relationship at low levels of strain. Once strain entered the upper range, however, predicted career commitment declined more sharply. This threshold pattern was poorly represented by Elastic Net but was clearly captured by CatBoost.

The result implies that technology does not need to be inherently detrimental to teacher commitment. Moderate digital responsibilities may be absorbed within ordinary professional adaptation. Problems become more pronounced when technology creates continual platform switching, additional documentation, surveillance-oriented analytics, constant availability, or repetitive technology-related administrative work.

Importantly, high professional identity did not completely neutralize severe digital-role strain. Teachers strongly attached to the profession could still exhibit reduced predicted commitment when the conditions under which they were expected to enact that identity became excessively burdensome.

5.6 Professional Learning Orientation

Continuous professional learning orientation contributed positively but less strongly than identity coherence, agency and organizational recognition.

This pattern suggests that willingness to learn remains important during technological transformation but should not be treated as a substitute for supportive occupational conditions. A teacher may be highly motivated to develop AI competence while simultaneously experiencing reduced commitment if professional learning is accompanied by expanding workload, insufficient autonomy or weak institutional recognition.

The model therefore challenges interpretations that locate responsibility for successful digital adaptation exclusively within individual teachers.

5.7 Overall Interpretation

The principal contribution of the analysis is the identification of **identity alignment rather than technology acceptance itself** as the central mechanism linking contemporary school transformation with career commitment.





The strongest simulated commitment profiles combined:

high professional identity coherence, strong agency, substantial organizational recognition, moderate-to-high professional autonomy, constructive AI-role integration, low digital-role strain, and continued orientation toward professional learning.

By contrast, weak commitment profiles were not defined simply by resistance to technology. Some profiles exhibited relatively positive AI integration but nevertheless showed lower career commitment because technological responsibilities were accompanied by weak agency and high role strain.

These findings demonstrate why explainable machine learning can complement conventional educational statistics. A regression coefficient may indicate that AI-role integration has an overall positive association with commitment, while masking the fact that this relationship changes substantially according to professional agency and digital-role strain.

Future Scope

Future research should validate the proposed framework using a large, multi-region dataset collected from practicing primary and secondary school teachers. A longitudinal design would be particularly valuable because professional identity and career commitment can change as teachers experience promotion, leadership transitions, policy reforms and technological innovation.

Subsequent studies should combine quantitative modelling with interviews or professional narratives. Such mixed-method research could explain why two teachers displaying similar numerical identity scores respond differently to AI-mediated professional change.

Longitudinal explainable-AI models could also investigate whether changes in digital-role strain precede changes in career commitment. Repeated measurements would permit trajectory analysis and potentially distinguish temporarily stressed teachers from individuals experiencing persistent professional disengagement.

Future modelling could additionally incorporate school-level hierarchical effects. Multilevel machine-learning or Bayesian hierarchical approaches would make it possible to separate individual teacher characteristics from organizational influences such as leadership climate, digital infrastructure and professional-development provision.

Another important direction concerns **human-AI professional complementarity**. Rather than asking only whether teachers use AI, research should measure which professional functions they are willing to delegate, retain or jointly perform with intelligent systems. Such measures could

provide a more precise account of how AI changes perceptions of expertise.

Cross-national research would also be valuable because professional identity is influenced by curriculum systems, regulatory environments, employment structures and cultural understandings of teacher authority.

Finally, future studies should compare predictive accuracy with practical interpretability. In educational policy settings, a slightly less accurate but highly transparent model may be preferable to an opaque system if predictions influence teacher support, workload allocation or retention interventions.

Conclusion

This study develops an integrated framework connecting **teacher professional identity, professional agency, organizational recognition, AI-role integration, digital-role strain and career commitment** within contemporary school education.

The simulation-based experiment demonstrates that career commitment can be represented more effectively when nonlinear relationships and interactions are considered. Explainable CatBoost modelling outperformed linear and conventional ensemble benchmarks in the simulated analytical environment, while SHAP interpretation identified professional identity coherence as the most influential construct.

The findings suggest that the professional consequences of educational AI cannot be reduced to whether teachers accept or reject technology. AI integration appears most constructive when teachers retain professional agency and perceive intelligent systems as supporting rather than displacing their pedagogical judgment. Conversely, high digital-role strain can undermine career commitment even when teachers possess a strong professional identity.

The broader implication is that teacher retention strategies should address not only workload and technical training but also **professional meaning**. Schools undergoing digital and AI-enabled transformation should preserve teacher autonomy, recognize professional expertise, involve teachers in technology-related decisions and ensure that new digital responsibilities remain compatible with the pedagogical purposes through which teachers define themselves.

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