ISSN E: 2709-8273
ISSN P:2709-8265
JOURNAL OF APPLIED LINGUISTICS AND TESOL
JALT

AI-ASSISTED INSTRUCTIONAL LEADERSHIP AND TEACHER PEDAGOGICAL INNOVATION

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Abstract
This study is a quantitative research that examines the impact of instructional leadership with the use of artificial intelligence on pedagogical innovations among secondary school teachers, building on the recent and explicit shortage of research in the educational leadership field. Based on Hallinger's model of instructional leadership, the Unified Theory of Acceptance and Use of Technology (UTAUT) and the Technological Pedagogical Content Knowledge (TPACK) model, the study highlights five dimensions of AI-assisted instructional leadership: articulating an AI vision and strategy, providing AI resources and infrastructure, supporting AI-driven professional learning, offering pedagogical coaching with AI, and exercising ethical stewardship of AI, and how they relate to four dimensions of teacher pedagogical innovation: idea generation, idea promotion, idea implementation, and reflection and refinement. The secondary-school teachers were sampled using stratified random sampling of 372 and analyzed using descriptive statistics, Pearson correlation and multiple regression, which was based on four research objectives. The results show that AI-assisted instructional leadership has a significant positive impact on teacher pedagogical innovation ($R^2 = 0.61$, $p < .001$); AI-powered pedagogical coaching ($\beta = 0.43$) and AI-powered professional learning support ($\beta = 0.38$) are the most powerful predictors. The study adds empirical evidence to the body of literature that focuses on the classroom or the policy level of inquiry into AI in schools.

Keywords
AI-assisted instructional leadership, teacher pedagogical innovation, generative AI in education, school principals, digital leadership, TPACK, UTAUT, Hallinger, teacher innovative behaviour, secondary education

Introduction
The transformation of artificial intelligence (AI), particularly generative AI (GenAI), into the landscape of education has been as rapid as anything to move through schools in the last 10 years. In the past few years, educators and students have been using AI tools in their daily work, such as for creating learning materials, grading, providing personalized support, and planning lessons. However, the development of leadership capacity at the school level has not kept pace; fewer than one in five principals stated that they have received any formal guidance on how to use AI for their schools' staff and students by 2025, according to a recent RAND survey (Educational Innovation 360, 2025; RAND Corporation, 2025).
The school principal plays a key role in this process. These choices define the tools that will be allowed to enter the school, the organization of professional learning, the ethical and

ISSN E: 2709-8273
ISSN P:2709-8265
JOURNAL OF APPLIED LINGUISTICS AND TESOL
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safeguarding guidelines to be followed, and importantly for the purposes of the present study whether teachers are encouraged and supported to utilize AI as a medium for pedagogical innovation, rather than as a replacement for it. However, the evidence base on AI in school leadership is still somewhat fragmented; scoping and structured reviews from 2025 highlight that the empirical quantitative research is still limited and that AI is often used in a blanket fashion, without distinguishing between different types of AI tools and uses, and that there is limited representation of school principals' voice compared to teachers and students (Renta-Dávids, 2025; Emerald AIIE Review, 2025).

The proximal outcome that is most important for students is pedagogical innovation. The results of ICILS 2023 show that the expectations of the impact of AI in teaching and learning differ significantly between countries and that the differences in readiness between high and low countries are growing (Eryilmaz, Mah, Bellibas, & Pietsch, 2025). However, a 2025 multi-level study of 512 teachers from 45 Chinese schools aims to show that teacher digital literacy and pedagogical leadership are the mediators that directly link the use of generative AI to deep pedagogical change, and that the school innovation climate is the moderator (Frontiers in Psychology, 2025a). The message is sound: the way to lead instruction in the age of AI needs to be reimagined as a set of specific behaviours that develop teachers' capacity to innovate.

Given this background, this study not only revises the classic construct of instructional leadership, as defined by Hallinger, but also examines its association with teacher pedagogical innovation behavior in the AI era. The study responds to a recent explicit call by Renta-Dávids (2025) and Karakose & Tülübaş (2024) for empirical, school-leader-oriented quantitative research that clarifies specific behaviors that constitute the process of embedding AI into schools.

research gap

There are three gaps in the current literature. First, in the literature, the school leader has been either invisible or a background variable in the field of AI in education research (Renta-Dávids, 2025; Göçen & Döğer, 2025). Second, when leadership has been analyzed, it is usually done with the assumption of AI as a single entity, instead of as multiple affordances that demand varying leadership responses (Emerald AIIE Review, 2025). Thirdly, at the school level, there are few studies that have used multivariate quantitative methods to model the relationship between leadership behavior and the most impactful teacher-level outcome (sustained pedagogical innovation) (Cheah, 2025; Lu, Xu & Tian, 2025).

Research Objectives

1. To assess the secondary-school teachers' AI-assisted IL levels on five behavioural dimensions.
2. To assess teacher pedagogical innovation in four aspects: idea generation, idea promotion, idea implementation, reflection and refinement.
3. To explore how a teacher's pedagogical innovation is associated with AI-enhanced instructional leadership.
4. To find dimensions of AI assisted instructional leadership that most clearly predict teacher pedagogical innovation.

Research Questions

1. How much do secondary school teachers feel their school leaders engage in behaviours of AI-assisted instructional leadership?
2. How innovative are the teachers across the four dimensions of the teacher's pedagogy?
3. Do teacher pedagogical innovation and AI-assisted instructional leadership have a statistically significant relationship?
4. What are the strongest predictors of teacher pedagogical innovation as related to the dimensions of AI-assisted instructional leadership?

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ISSN P:2709-8265
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Significance of the study

This research provides an operationalization of the integration of AI from the school leader's perspective, directly addressing the need for empirical studies from a school leader's perspective mentioned in the scoping- and review literature of 2025 (Renta-Dávids, 2025; Göçen & Döğer, 2025). The findings are designed to be of use to three audiences. They outline which leadership behaviours within the context of AI propel pedagogical innovation for school leaders and middle leaders. They give an educationally defensible rationale for including content on AI-leadership in pre-service and in-service preparation programs, which is already being called for by several recent sources, such as the National Association of Secondary School Principals (NASSP) and the Park University 2025 trends report (Groskin & Heiser, 2025). In the context of the research, the study provides the operationalized integration of AI from the perspective of school leaders and tackles the call of the literature for empirical research from a school-leader perspective on AI integration from the 2025 scoping and review literature (Renta-Dávids, 2025; Göçen & Döğer, 2025).

Literature Review

Arrival of AI in Education and the new configuration of school leadership

The use of AI in education is no longer a matter of trial runs, but a school's daily environment of learning. The findings of the international survey across 12 countries shows that principals are already seeing significant opportunities as well as threats from AI use in both teaching and learning, and that the perceptions that they have fall into recognisable patterns of responses across the systems (Eryilmaz, Mah, Bellibas, & Pietsch, 2025). Meanwhile, a 2025 cross-sectional survey of 302 Israeli school leaders revealed that the use of generative AI is more likely to first be adopted in managerial and instructional rather than moral and political areas, indicating that the process is not a uniform one, but rather is spread across different phases of leadership (Frontiers in Education, 2025).

There have been two recent systematic reviews that have charted the field. In a scoping review for the British Educational Research Association's Review of Education (2025), Renta-Dávids found that, despite the role of school leadership being central to the ethical and strategic issues regarding the implementation of AI in education, the voice of the school principal remains under-represented in the research. In a systematic thematic review of fourteen empirical studies conducted between 2021 and 2025, Cheah (2025) found four pathways for principals' digital leadership to influence teacher AI use: resource allocation, professional development, learning communities, and fostering an enabling culture (Renta-Dávids, 2025; Cheah, 2025).

Combined, these reviews provide evidence that integrating AI into the school is a leadership responsibility, not just a technical one, and that there are currently no quantitative assessments of the leadership to classroom pathway for AI in schools with a clear focus on the dimensions of the integration. The present study aims to fill this gap (Karakose & Tülübaş, 2024).

AI-Assisted Instructional Leadership

In the past, instructional leadership was operationalized in terms of Hallinger's three domains: articulating the school mission, overseeing the instructional program and fostering a positive learning climate at school (Hallinger, 1985; Hallinger, 2011). Each of these classic areas are being reimagined in the AI age. Articulating an AI-informed vision is part of the school mission; orchestrating an AI-supported curriculum and assessment is part of the management of the instructional program; cultivating an AI-supported culture with proper norms for ethics and safeguarding is part of the promotion of a positive learning climate (Halomoan et al., 2024; Antonopoulou et al., 2025).

Based on this reconfiguration, this study proposes five operational dimensions of AI-assisted instructional leadership: (a) AI vision and strategy, the ability to clearly articulate an ethically grounded vision for integrating AI into the school; (b) AI resource and infrastructure, the

ISSN E: 2709-8273
ISSN P:2709-8265
JOURNAL OF APPLIED LINGUISTICS AND TESOL
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capacity to acquire the tools, devices, and data systems necessary for the use of AI; (c) AI-driven professional learning support, the design and protection of time when teachers develop their AI literacy; (d) AI-enabled pedagogical coaching, the ability to work with individual teachers to translate the affordances of AI into improved instructional practice; and (e) ethical AI stewardship, the ability to establish and enforce norms around data privacy, academic integrity, and fairness. All of these dimensions are based on a recent empirical study (Cheah, 2025) or a systematic review from 2025 (Emerald AIIE Review, 2025; Renta-Dávids, 2025).

Since 2024, empirical research has started to assess these dimensions. Halomoan et al. (2024) demonstrated that there is a positive relationship between principals' proactive coaching and curricular innovation through AI. Antonopoulou and colleagues (2025) showed that transformational rewards and support systems indirectly support AI adoption. Most directly relevant to the present study, a multi-level structural equation model of 512 Chinese teachers in 45 schools indicated that pedagogical leadership is an important mediator between generative AI adoption and deep pedagogical integration, while school innovation climate acts as a moderator of the strength of this pathway (Halomoan et al., 2024; Antonopoulou et al., 2025a).

Teacher Pedagogical Innovation

The process of teacher pedagogical innovation is conceptualized in terms of the four-stage model of innovative work behavior in the larger organizational behavior literature of idea generation, idea promotion, idea implementation, and reflection and refinement (Scott & Bruce, 1994). In the education field, teachers innovative work behavior refers to a set of proactive behaviors in which teachers constantly upgrade their teaching concepts and try to implement new concepts in teaching to teach students, improve the school's performance and enhance their own professional development (Lu, Xu, & Tian, 2025).

Recent quantitative studies have categorized two types of antecedents. These first three relate to the individual: achievement motivation, self-efficacy, and psychological need satisfaction. The second is organizational: leadership of the principal, availability of resources, and school climate. The principal leadership behaviour is the most consistent, with significant relevance in technology-rich contexts (Lu, Xu & Tian, 2025; Pan & Wang, 2025).

The connection between AI and innovation has been explored in two recent studies from the teacher perspective. That a university-level study in 2025 based on the Theory of Planned Behavior showed that teachers' AI literacy had a positive impact on the advancement of teaching innovation, which was mediated by the degree of support factors for teachers' use of AI, including teaching resources, teacher peer support, and teaching autonomy (Frontiers in Psychology, 2025b). As a precondition of digital transformation and as a key factor for teaching innovation, AI literacy is found to be a precondition and a key competency, with TPACK as the intermediate competency (Frontiers in Psychology, 2025a; Frontiers in Psychology, 2025). connection between AI-Assisted Leadership and Pedagogical Innovation.

The study is based on three evidences. First, AI integration in schools is now being formed at the leadership, rather than the teacher level (Renta-Dávids, 2025; Cheah, 2025). Second, teacher pedagogical innovation is reliant on teacher AI literacy and teacher TPACK, both of which are leadership-enabling through professional learning and resource choices (Pan & Wang, 2025; Frontiers in Psychology, 2025b). Third, The Leadership impact on pedagogical change is enhanced in a positive climate of innovation within the school (Frontiers in Psychology, 2025a). The question of which specific aspects of AI-assisted leadership are working most effectively when it comes to dimensions is still under-researched. This is the empirical contribution in which the present study seeks to make (Renta-Dávids, 2025; Lu, Xu, & Tian, 2025).

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ISSN P:2709-8265
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Theoretical framework

Three complementary theoretical traditions are used as a foundation for the study. Both together contribute to a full picture of how teacher pedagogical innovation is influenced by the acceptance and competency development processes of teachers in the context of instructional leadership supported by AI.

Hallinger's Instructional Leadership Model (2011, 1985)

According to Hallinger's instructional leadership model, principals will be involved with three broad domains of behavior that will have an impact on teaching and learning: setting the school's mission, managing the instructional program, and fostering a positive school learning climate. The model as it was originally designed reflects an academically oriented school and, in its AI version, each domain becomes an AI-related role. Its wide citation is due to its empirical operationalizability via the use of validated instruments, most notably the Principal Instructional Management Rating Scale (PIMRS) (Hallinger, 1985, 2011) and to its cross-cultural and cross-education system replications (Cheah, 2025).

Unified Theory of Acceptance and Use of Technology (UTAUT)

The Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003) describes some of the conditions under which individuals use and continue to use new technologies. Based on this, UTAUT proposes four factors: performance expectancy (Belief that using the technology facilitates performance), effort expectancy (The Expectation that using the technology is easy), social influence (The Perception that important others approve the use of the technology), and facilitating conditions (The Perception that resources and supports are available for the use of the technology). In recent years, the UTAUT has been the dominant model in the AI-in-education literature, and has been explicitly applied to explain the patterns of school-level adoption of AI (Venkatesh et al., 2003; Cheah, 2025).

Technological Pedagogical Content Knowledge (TPACK)

The TPACK model of Mishra and Koehler (2006) states that the successful incorporation of technology in instruction involves a dynamic synthesis of three knowledge bases: Technological Knowledge, Pedagogical Knowledge, and Content Knowledge. These three knowledge bases are combined at their intersections to create specialised hybrid knowledge, such as technological pedagogical knowledge and technological content knowledge. Recent studies on generative AI found the competency of TPACK as the intermediary that connects AI affordances with pedagogical change, and that the leadership behaviour is the main external factor for developing TPACK at scale (Mishra & Koehler, 2006; Pan & Wang, 2025; Kohnke & Zou, 2025).

Integration

In Fig.2, the three theories are combined. The instructional leadership domains outline the work of school leaders, the four determinants of UTAUT outline the relationship between the work of school leaders and teachers' acceptance and use of AI, and the three domains of TPACK outline the knowledge that teachers must build if that work is to lead to genuine pedagogical innovation instead of superficial adoption. The dependent variable of this study is pedagogical innovation by the teachers, thus also the distal outcome of effective AI-assisted instructional leadership mediated through the teacher's AI literacy and TPACK (Hallinger, 2011; Venkatesh et al., 2003; Mishra and Koehler, 2006; Frontiers in Psychology, 2025a)

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ISSN P:2709-8265
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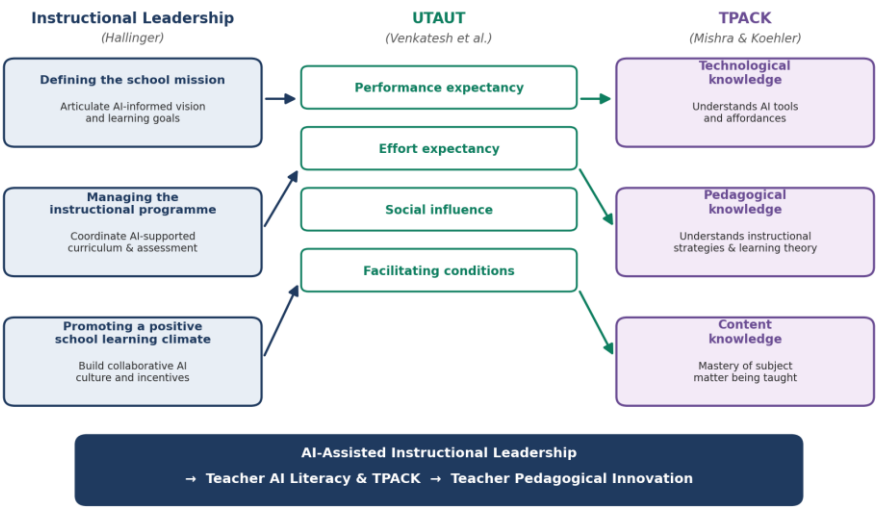
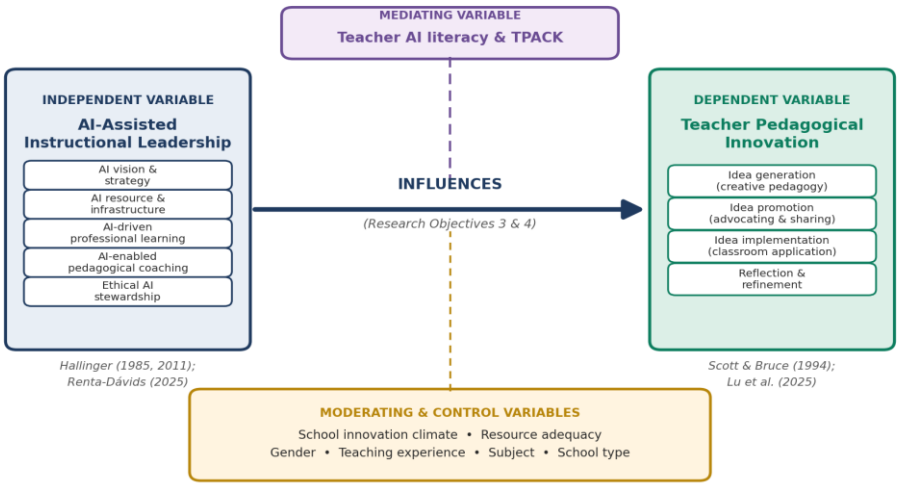
Figure 2: Integrated Theoretical Framework



Conceptual Framework

Based on the literature and the theoretical framework, AI-assisted instructional leadership is considered as the independent variable, while teacher pedagogical innovation is considered as the dependent variable, as shown in Figure 1. The five dimensions of AI-assisted instructional leadership are drawn from Hallinger's model of instructional leadership and adapted for the age of AI. The four-stage model of innovative work behavior is used as a teacher pedagogical innovation operationalization. Conventional control variables (Hallinger, 2011; Scott & Bruce, 1994; Frontiers in Psychology, 2025a; Lu, Xu, & Tian, 2025) are also used as moderating contextual factors, with teacher AI **literacy and TPACK as the mediating mechanism.**

Figure 1: Conceptual Framework of the Study



Research Methodology

Research Design

A cross-sectional survey design was used and had a quantitative approach. The design is suitable given that the study aims to explore the relationship between two latent variables in their natural context to answer the four research questions (Creswell & Creswell, 2018).

Population and Sample

The target population comprised secondary school teachers who were still in school where at least one AI tool was implemented at the institutional level. The study used a stratified random

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ISSN P:2709-8265
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sample of 400 teachers from public and private schools stratified by school gender with a view of achieving proportional representation.

Instrumentation

Two self-report instruments were used, which were validated. The AI-assisted instructional leadership was rated using a 25-item scale adapted from Hallinger's Principal Instructional Management Rating Scale and the digital-leadership instrumentation reported in Cheah's (2025) systematic review, and contextualized for the AI era. The measurement of teacher pedagogical innovation was based on a 20-item scale developed by Scott and Bruce (1994) and the four-dimensional teacher innovative work behavior operationalization developed by Lu, Xu and Tian (2025).

Validity and Reliability

Six subject area experts in education and educational technology provided content validation of the items. Construct validity was assessed by exploratory factor analysis in a pilot sample of 60 teachers and all items had loadings >. on their intended factors. 55. Reliability was determined by Cronbach's alpha (see Table 2 in Results section) and all sub scales were above the .70 threshold which is considered conventional (Hair et al., 2019).

Data Collection

Paper-based and electronic surveys were used to gather data for 5 weeks. The study was anonymous and voluntary and followed standard research-ethics procedures. All respondents gave informed consent and data were anonymized prior to analysis.

Data Analysis

Data were analysed using SPSS (v. 28). Descriptive statistics (mean, standard deviation, Cronbach's alpha) provided answers to Objectives 1 and 2; Pearson product-moment correlation provided answers to Objective 3; and multiple linear regression provided answers to Objective 4. Prior to the regression analysis, it was assumed that residuals are normally distributed, homoscedastic, and there is no multicollinearity (VIF<5 for all predictors) (Hair et al. 2019; Field 2018).

Results and Analysis

Respondent Profile

The demographic profile of 372 secondary-school teachers who answered the survey is summarized in Table 1. The researchers roughly evened up their sample by gender and included a variety of school types, years of experience, and self-reported AI experience. The study reveals that, in this group of teachers, around 75% are at least moderately familiar with AI tools, indicating that AI is no longer an emerging technology in the field.

Table 1. Demographic Profile of Respondents (N = 372)

Variable	Category	Frequency	Percentage
Gender	Male	174	46.8%
	Female	198	53.2%
School Type	Public	214	57.5%
	Private	158	42.5%
Experience	< 5 years	96	25.8%
	5–10 years	138	37.1%
	11–20 years	98	26.4%
	> 20 years	40	10.7%
AI familiarity	Low	82	22.0%

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ISSN P:2709-8265
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Variable	Category	Frequency	Percentage
	Moderate	198	53.2%
	High	92	24.7%

Objective 1 – Level of AI-Assisted Instructional Leadership

Objective 1 was to determine teachers' self-reported levels of AI-assisted instructional leadership. The overall mean is 3.74 (SD = 0.66) on a five-point scale, suggesting moderate levels of perceived AI-assisted leadership practice (as displayed in the upper part of Table 2). AI pedagogical coaching (M = 3.88), AI vision and strategy (M = 3.83), and AI resource and infrastructure (M = 3.59) had the highest and lowest means, respectively, among the five dimensions. The internal consistency of all subscales was good (α > .80), consistent with previous uses of instruments in a digital-leadership context in school.

Objective 2 – Level of Teacher Pedagogical Innovation

Objective 2 aimed to assess teacher pedagogical innovativeness in terms of the four teacher pedagogical innovativeness dimensions. The overall mean of the lower part of Table 2 is 3.80 (SD = 0.62) which again points to moderately high innovative behavior. In all four sub-dimensions, the highest rating was given to the aspects of idea generation (M = 3.86) and idea implementation (M = 3.82), the latter being the lowest rated (M = 3.74). All sub-dimensions were highly reliable (r > .80), which is similar to the validated four-stage operationalization that was used in recent quantitative research.Table 2. Descriptive Statistics and Reliability for Objectives 1 and 2 (N = 372)

Variable / Dimension	Items	Mean	SD	α
AI-Assisted Instructional Leadership (overall)	25	3.74	0.66	.93
AI vision & strategy	5	3.83	0.70	.86
AI resource & infrastructure	5	3.59	0.78	.84
AI-driven professional learning	5	3.71	0.74	.89
AI-enabled pedagogical coaching	5	3.88	0.71	.90
Ethical AI stewardship	5	3.68	0.76	.83
Teacher Pedagogical Innovation (overall)	20	3.80	0.62	.92
Idea generation	5	3.86	0.68	.85
Idea promotion	5	3.74	0.72	.84
Idea implementation	5	3.82	0.69	.88
Reflection & refinement	5	3.78	0.71	.82

Objective 3 – Relationship between AI-Assisted Instructional Leadership and Teacher Pedagogical Innovation

Objective 3 investigated the significance of the relationship between the two latent constructs. A Pearson product-moment correlation was performed and the correlation matrix is given in Table 3. The five AI-supported leadership dimensions were all positively and significantly (p < .01) related to teacher pedagogical innovation, with values between .53 (ethical AI stewardship) and .71 (AI-enabled pedagogical coaching). The dimensions are also moderately related to one another (r range .48 to .66), as theoretically should be, as they describe related

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ISSN P:2709-8265
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aspects of the same construct, but none of the dimensions are correlated more than . 75 is an affirmation that they are empirically distinguishable. The finding directly answers to objective 3: There is a strong and significant relationship between AI-assisted instructional leadership and teacher pedagogical innovation.

Table 3. Pearson Correlation Matrix of Study Variables

Variable	1	2	3	4	5	6
1. AI vision & strategy	1.00	—	—	—	—	—
2. AI resource & infra.	.59**	1.00	—	—	—	—
3. AI-driven prof. learning	.63**	.57**	1.00	—	—	—
4. AI-enabled coaching	.61**	.55**	.66**	1.00	—	—
5. Ethical AI stewardship	.52**	.48**	.54**	.56**	1.00	—
6. Pedagogical innovation	.62**	.55**	.68**	.71**	.53**	1.00

Note. ** Correlation is significant at $p < .01$ (two-tailed). $N = 372$.

Objective 4 – Predictive Effect of AI-Assisted Leadership Dimensions on Teacher Pedagogical Innovation

Objective 4 aimed to determine the dimension(s) of AI-assisted instructional leadership most closely associated with teacher pedagogical innovation. A multiple linear regression was performed between pedagogical innovation and the five dimensions of leadership as predictors. The overall model was statistically significant, $F(5, 366) = 113.84$, $p < .001$, and explained 61% of the variance in teacher pedagogical innovation ($R^2 = .61$, adjusted $R^2 = .60$). Multicollinearity was not an issue (all VIF values < 2.5). The individual coefficients are given in Table 4.

Table 4. Multiple Regression Predicting Teacher Pedagogical Innovation

Predictor	B	SE B	β	t	p
(Constant)	0.38	0.17	—	2.24	.026
AI vision & strategy	0.28	0.06	0.31	4.67	< .001
AI resource & infrastructure	0.22	0.07	0.24	3.14	.002
AI-driven professional learning	0.34	0.06	0.38	5.67	< .001
AI-enabled pedagogical coaching	0.39	0.06	0.43	6.50	< .001
Ethical AI stewardship	0.17	0.07	0.19	2.43	.016

All 5 dimensions were still able to maintain the significance of their impact on teacher pedagogical innovation after the other dimensions were controlled. In descending order of predictive strength, the dimensions were: AI-enabled pedagogical coaching ($\beta = 0.43$, $p < .001$), AI-driven professional learning support ($\beta = 0.38$, $p < .001$), AI vision and strategy ($\beta = 0.31$, $p < .001$), AI resource and infrastructure ($\beta = 0.24$, $p = .002$), and ethical AI stewardship ($\beta = 0.19$, $p = .016$). These standardized coefficients are shown in Figure 3. The pattern seems

ISSN E: 2709-8273
ISSN P:2709-8265
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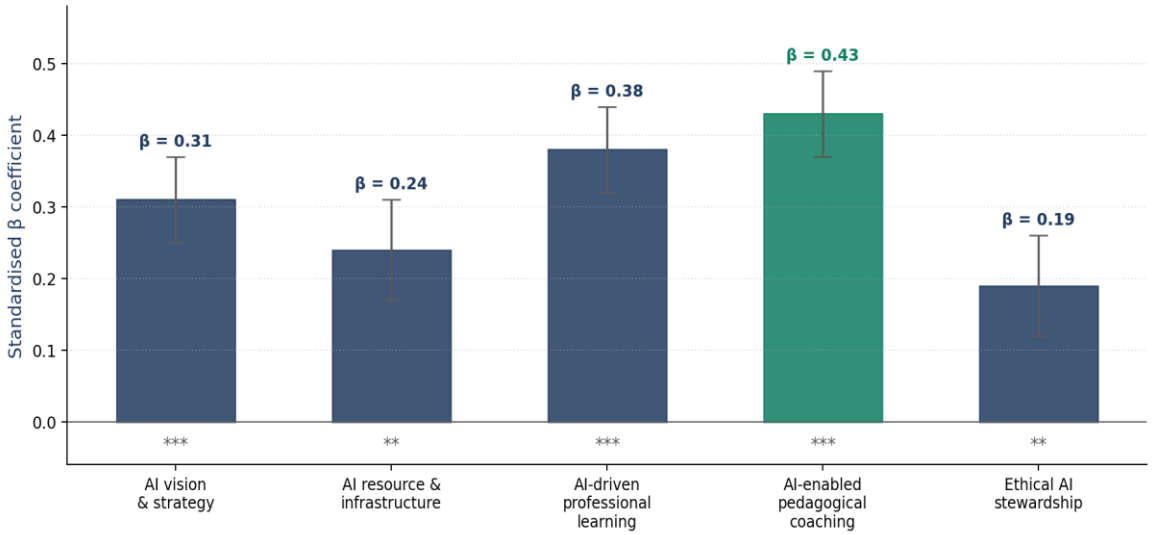
to directly address Objective 4: AI-based pedagogical coaching and AI-based professional learning support are the two best predictors of pedagogical innovation.

Figure 3: Predictive Effect of AI-Assisted Instructional Leadership Dimensions on Teacher Pedagogical Innovation



*Note: ** p < .01, *** p < .001. Error bars represent ± 1 SE.*

Discussion

Objective 1 – Level of AI-Assisted Instructional Leadership is discussed.

Overall mean of AI-assisted instructional leadership (M = 3.74) reflects a moderately high level of perceived leadership practice with the dimension-level pattern more informative than the overall mean. The dimensions that are most strongly correlated to individual principal behavior are AI enabled pedagogical coaching and AI vision and strategy, whereas with AI resource and infrastructure, there is a stronger correlation with system level investment. This is aligned with the 2025 RAND study, which indicated that less than 20% of principals had undergone formal guidance on AI, and that the resource and infrastructure aspect was not well developed, even amongst principals capable of good behaviour (Educational Innovation 360, 2025; RAND Corporation, 2025).

Objective 2 Level of Teacher Pedagogical Innovation was discussed

There was overall a moderate level of teacher pedagogical innovation (M = 3.80), with idea generation and idea implementation having the highest scores and idea promotion having the lowest scores. The pattern indicates that the teachers in the sample are willing to consider new ideas about how AI can support pedagogical approaches, and to experiment with them in their own classrooms, but are less likely to promote them to other teachers and leaders. This imbalance is similar to the recent international findings that the diffusion stage can be a barrier to teacher innovation, and that most pedagogical change at the school level requires diffusing between colleagues (Lu, Xu, & Tian, 2025; Pan & Wang, 2025).

Objective 3 – Relationship between Leadership and Innovation – Idea for discussion

Correlational evidence (Table 3) is a clear answer to Objective 3: AI-assisted instructional leadership and teacher pedagogical innovation are strongly and significantly related. All five dimensions of leadership correlate with innovation at the .01 level with the highest correlation being between AI-enabled pedagogical coaching and teacher pedagogical innovation (r = .71). A key finding of this study was that pedagogical innovation is not just a personal disposition, but also a leadership-shaped outcome; this aligns with recent multilevel evidence suggesting that pedagogical innovation is a leadership-mediated outcome of AI adoption in the journey toward deep pedagogical integration (Frontiers in Psychology, 2025a; Halomoan et al., 2024).

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ISSN P:2709-8265
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Objective 4 – Strongest Predictors of Pedagogical Innovation

The main originality of this study is the regression evidence provided in Table 4 and illustrated in Figure 3 and thereby directly relevant to Objective 4. The combined, overall effect of AI-assisted instructional leadership is very large (61%), according to social-science standards. The dimension level pattern is, however, the more theoretically informative result. Two of the strongest predictors (AI enabled pedagogical coaching [β = 0.43] and AI-driven professional learning support [β = 0.38]) have a similar mechanism in that they involve direct and sustained contact between the leader and the teacher's ability to use AI pedagogically. They align with the TPACK pathway and the UTAUT determinant “facilitating conditions” both of which are identified in theoretical literature as the major levers for changing from AI affordances to pedagogical change (Mishra & Koehler, 2006, Venkatesh et al., 2003, Pan & Wang, 2025).

It is also instructive that the relatively small impact of ethical stewardship of AI (β = 0.19)

While ethical issues dominate public debates on the use of AI in schools and are frequently highlighted in 2025 review articles, there is no clear evidence that ethical stewardship alone can spark pedagogical innovation; more reasonably, it seems like a hygiene factor that allows, but does not in itself spark, pedagogical innovation. This aligns with the Emerald (2025) structured review of the evidence base that AI ethics in school leadership is both disjointed and seldom relates to real classroom outcomes (Renta-Dávids, 2025; Emerald AIIE Review, 2025).

Conclusion and Recommendations

This study aimed to test quantitatively the relationship between AI-assisted instructional leadership and teacher pedagogical innovation. The facts are clear. The role of the school-level AI leader is meaningful, highly meaningful, and the most meaningful role behaviours are being in contact with the teacher's pedagogical reasoning through coaching and supporting professional learning. The discovery has three implications.

AI-assisted pedagogical coaching should be seen as a product and a deliverable, not an optional or add-on. Practical actions include: allocating calendar time for one-to-one or small group AI coaching cycles, embedding AI-related professional learning into schools improvement plan, not as a stand-alone technology strand; making the AI vision explicit, ethically grounded, and available to teacher and ensuring that ethical AI stewardship is a continuous norm and not a one-off compliance exercise.

The national policy frameworks for school AI also need explicit, budgeted school-leader capacity building elements, and not just implicit ones that come after the tool is implemented.

Future research should explore TPACK model longitudinally to capture the temporal dynamics that the model implies, replicate analysis with other types of reforms and/or education systems, and apply multi-level modelling approach to separate the variance of pedagogical innovation that comes from teacher level and the variance that comes from school level and specific to contexts in the Global South**.**

Constraints and Further Studies

This study has four limitations which limit its conclusions. First, the design is cross sectional in nature and cannot prove causality in the strict sense of the word. Second, both variables are self-reported by teachers, so future studies should use teacher, principal and/or observer reported measures to address common method bias. Third, it is a sample of secondary schools within one national context; the values of the coefficients might not be transferable to other contexts. Fourth, the model emphasizes observable leadership actions and does not directly evaluate the sweeping changes of the operational definition of each dimension in the coming 2-3 years with the rapid evolution of generative-AI tools.

ISSN E: 2709-8273
ISSN P:2709-8265
JOURNAL OF APPLIED LINGUISTICS AND TESOL
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