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ORIGINAL

AI Literacy and Digital Competencies Among Higher Education Faculty: Examining the Relationship with Teaching Effectiveness and Professional Development Readiness

Alfabetización En IA Y Competencias Digitales Entre El Profesorado De Educación Superior: Un Examen De La Relación Con La Eficacia Docente Y La Disposición Para El Desarrollo Profesional

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ABSTRACT

Introduction: the rapid advancement of artificial intelligence and digital technologies has created new requirements for faculty professional development in higher education. This study examines connections between AI literacy, digital competencies, institutional support, technological self-efficacy, teaching effectiveness, and professional development readiness.
Objective: to investigate how AI literacy, digital competencies, institutional support, and technological self-efficacy affect professional development readiness among higher education faculty, with teaching effectiveness as a mediating factor.
Method: a cross-sectional survey was conducted with 412 faculty members from various higher education institutions between September 2024 and January 2025. Data were analyzed using PLS-SEM to examine direct effects and mediation relationships.
Results: all four independent variables significantly influenced teaching effectiveness (digital competencies β=0,324, AI literacy β=0,298, technological self-efficacy β=0,203, institutional support β=0,185) and professional development readiness. Teaching effectiveness strongly predicted professional development readiness (β=0,487) and partially mediated all relationships (VAF: 41,7 %-50,5 %).
Conclusions: teaching effectiveness serves as a crucial mediating mechanism through which AI literacy, digital competencies, institutional support, and technological self-efficacy enhance faculty professional development readiness. These findings suggest that comprehensive faculty development programs should simultaneously address multiple technological competencies while emphasizing practical teaching applications.

Keywords: AI Literacy; Digital Competencies; Teaching Effectiveness; Professional Development Readiness; Higher Education Faculty; Institutional Support.

RESUMEN

Introducción: el rápido avance de la inteligencia artificial y las tecnologías digitales ha creado nuevos requisitos para el desarrollo profesional del profesorado en educación superior. Este estudio examina las conexiones entre alfabetización en IA, competencias digitales, apoyo institucional, autoeficacia tecnológica, eficacia docente y preparación para el desarrollo profesional.
Objetivo: investigar cómo la alfabetización en IA, las competencias digitales, el apoyo institucional y la autoeficacia tecnológica afectan la preparación para el desarrollo profesional entre el profesorado de educación

superior, con la eficacia docente como factor mediador.
Método: se realizó una encuesta transversal con 412 docentes de diversas instituciones de educación superior entre septiembre de 2024 y enero de 2025. Los datos se analizaron mediante PLS-SEM para examinar efectos directos y relaciones de mediación.
Resultados: las cuatro variables independientes influyeron significativamente en la eficacia docente (competencias digitales β=0,324, alfabetización en IA β=0,298, autoeficacia tecnológica β=0,203, apoyo institucional β=0,185) y la preparación para el desarrollo profesional. La eficacia docente predijo fuertemente la preparación para el desarrollo profesional (β=0,487) y medió parcialmente todas las relaciones (VAF: 41,7 %-50,5 %).
Conclusiones: la eficacia docente funciona como un mecanismo mediador crucial a través del cual la alfabetización en IA, las competencias digitales, el apoyo institucional y la autoeficacia tecnológica mejoran la preparación del profesorado para el desarrollo profesional. Estos hallazgos sugieren que los programas integrales de desarrollo del profesorado deben abordar simultáneamente múltiples competencias tecnológicas mientras enfatizan aplicaciones prácticas de enseñanza.

Palabras clave: Alfabetización en IA; Competencias Digitales; Eficacia Docente; Preparación para el Desarrollo Profesional; Profesorado de Educación Superior; Apoyo Institucional.

INTRODUCTION

The rapid advancement of artificial intelligence and digital technologies has dramatically reshaped higher education landscapes, creating new requirements for faculty professional development and technological adaptation.[1,2] As educational institutions globally navigate digital evolution, the need for faculty to develop AI literacy and digital competencies has become crucial for maintaining educational quality and preparing students for an increasingly digitized environment.[3] Faculty readiness for professional development, representing educators' willingness and capability to participate in lifelong learning and skill advancement, has become a vital outcome measure for understanding how technological competencies contribute to sustained professional advancement.[4]

The integration of AI technology in learning environments has generated both possibilities and challenges for higher education educators. Although AI applications provide opportunities for enhanced teaching methodologies, individualized learning trajectories, and superior educational outcomes, they also necessitate faculty development of competencies that extend beyond conventional subject matter knowledge.[5] Preparedness for professional development serves as a critical measure of faculty capacity to adapt to technology advancements and engage in continuous learning essential for effective AI integration.[6]

Digital competencies, representing the broad range of technology-related abilities and knowledge, support AI literacy in preparing faculty for digital transformation. These capabilities include digital content development, online interaction, data interpretation, cybersecurity understanding, and the capacity to evaluate and incorporate digital resources into educational methods.[7,8] The cultivation of digital competencies alongside AI literacy establishes a Foundation for continuous professional advancement and technological adaptation.[9]

Organizational support and technological self-efficacy are crucial environmental and individual factors that may influence preparedness for professional growth. Organizational support encompasses institutional resources, policies, and cultural factors that facilitate technology adoption and professional development.[10] Technological self-efficacy denotes educators' conviction in their ability to utilize technological resources for instructional purposes.[11] Both factors may directly influence teacher readiness to engage in professional development initiatives and adjust to technological advancements.

Teaching effectiveness functions as a potential mediating factor connecting technological competencies and contextual elements to professional development readiness. Educators who effectively integrate technology into their teaching methods and attain favorable educational outcomes may have heightened motivation and confidence for further professional development.[12] The relationship between effective teaching experiences and motivation for professional growth suggests that teaching effectiveness may moderate the impact of AI literacy, digital skills, organizational support, and technological self-efficacy on readiness for professional development.[13]

Despite the increasing significance of these linkages in higher education, empirical research examining the impact of various technical and contextual elements on professional development preparedness via teaching effectiveness remains limited.[14] Recent research has primarily concentrated on singular components or direct correlations, neglecting the intricate mediation mechanisms that elucidate how technical abilities translate into enduring professional progression.[15]

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Theoretical Framework

This research integrates two theoretical frameworks: the Technology Acceptance Model (TAM) and Self-Determination Theory (SDT). The Technology Acceptance Model, originally formulated by Davis in 1989, elucidates technology uptake and utilization through perceived usefulness, perceived ease of use, and behavioral intentions.[16] TAM extensions have incorporated elements such as organizational support, self-efficacy, and individual capabilities as predictors of technology adoption and implementation.[17,18]

Self-Determination Theory, proposed by Deci and Ryan, explores the psychological necessities for relatedness, autonomy, and competency as drivers of motivation.[19] SDT is particularly relevant to professional development readiness as it emphasizes the significance of intrinsic motivation, competency enhancement, and supportive settings in encouraging long-term behavioral changes and learning.[20] By elucidating the relationship between technical skill, organizational support, and the satisfaction of fundamental psychological demands for competence and autonomy, the theory contributes to understanding professional development readiness.

This study aims to investigate how AI literacy, digital competencies, organizational support, and technological self-efficacy affect professional development readiness among higher education faculty, with teaching effectiveness functioning as a mediating factor.

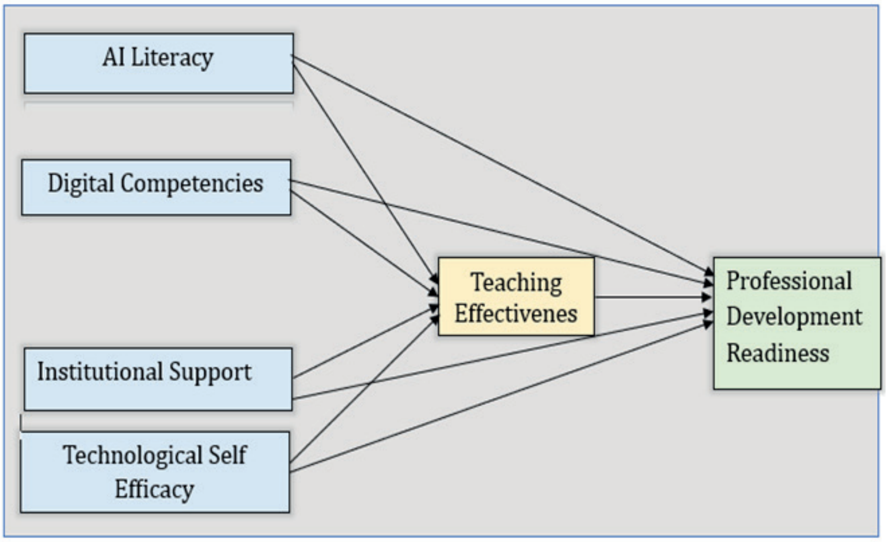

Figure 1. Conceptual Framework

METHOD

Research Design and Sample

This study employed a quantitative research approach with cross-sectional survey methodology to gather data from higher education faculty across various institutions.[21] The target population included faculty members from diverse disciplines at universities and colleges, including assistant professors, associate professors, and full professors with minimum one year of teaching experience.

Participants were required to have instructional responsibilities in higher education and basic familiarity with digital technologies. A stratified random sampling method was employed to recruit participants from different institutional categories (research universities, teaching-focused colleges, community colleges), academic fields (STEM, humanities, social sciences, professional programs), and career levels (early-career, mid-career, senior faculty).

Ethical Aspects

This study received ethical approval from the Institutional Ethics Committee of Avinashilingam Institute for Home Science and Higher Education for Women (Approval No: IEC/AIHSSHE/2024/087, dated August 15, 2024). All participants provided informed consent prior to participation. Participants were assured of confidentiality and anonymity, and were informed of their right to withdraw at any time without consequences. Data were stored securely and accessible only to the research team.

Data Collection

Data collection occurred between September 2024 and January 2025. A detailed survey instrument was constructed based on established scales and modified for the higher education context. The questionnaire was reviewed by five educational technology experts and pilot-tested with 75 faculty members to ensure clarity, relevance, and reliability.

The pilot study confirmed acceptable psychometric properties for all scales. Exploratory Factor Analysis (EFA) was conducted on the pilot data for the newly developed AI Literacy scale, revealing a unidimensional structure with factor loadings ranging from 0,76 to 0,89. Cronbach's alpha for the AI Literacy scale in the pilot was 0,91, indicating excellent internal consistency. Based on pilot feedback, minor wording adjustments were made to three items to enhance clarity.

The final questionnaire was distributed through various channels including institutional email lists, professional association networks, academic conferences, and social media platforms. A total of 650 questionnaires were distributed, producing 456 responses for a response rate of 70,2 %. After removing incomplete responses, 412 usable responses were retained for analysis.

Measures

All constructs were measured using established scales adapted for the higher education context, with responses collected on 7-point Likert scales ranging from "strongly disagree" (1) to "strongly agree" (7).

AI Literacy was measured using a 6-item scale developed specifically for this study following paradigm for scale development. Item generation was informed by extensive literature review and expert consultation. The items assess faculty engagement with AI technologies, understanding of AI capabilities and limitations, integration of AI tools in educational practice, and ethical considerations. As mentioned above, the scale underwent rigorous pilot testing including EFA, which confirmed its unidimensional structure and acceptable reliability ($\alpha = 0,91$).

Digital Competencies was measured using a 5-item scale adapted from the DigComp framework European Commission evaluating faculty skills in digital content creation, online communication, and technology integration.[22]

Institutional Support was measured using a 5-item scale adapted from Scherer et al.[23] assessing perceptions of institutional resources, policies, and support for technology adoption.

Technological Self-Efficacy was measured using a 4-item scale based on Compeau and Higgins evaluating faculty confidence in learning and using technology.[24]

Teaching Effectiveness was measured using a 6-item scale based on Day and Gu assessing student engagement, learning support, and pedagogical quality.[25]

Professional Development Readiness was measured using a 5-item scale adapted from Guskey evaluating faculty motivation for continuous learning and willingness to engage in professional growth activities.[26]

Data Analysis

Data analysis was conducted using SmartPLS 4.1.1.2 software employing the PLS-SEM approach.[27] The analysis followed a two-stage approach: first, evaluation of the measurement model for reliability and validity, and second, assessment of the structural model for hypothesized relationships and mediation effects.

Measurement Model Assessment

Before examining structural relationships, we rigorously assessed the measurement model. Internal consistency reliability was evaluated using both Cronbach's Alpha and Composite Reliability (CR), with threshold values of 0,70. Convergent validity was assessed through Average Variance Extracted (AVE), requiring values above 0,50. Discriminant validity was examined using both the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio, with HTMT values below 0,85 indicating adequate discriminant validity. All constructs met these established thresholds, as detailed in the results section.

RESULTS

Demographic Profile

Table 1 presents the demographic characteristics of the respondents. The sample comprised 56,8 % male, 41,7 % female, and 1,5 % non-binary faculty. Most participants were aged 35-44 years (35,7 %), followed by 45-54 years (27,2 %). Assistant professors constituted the largest group (40,8 %), with representation across STEM (37,9 %), social sciences (23,8 %), business/professional fields (20,9 %), and humanities (17,5 %). Nearly half the respondents (48,1 %) were from research universities, with teaching colleges (32,5 %) and community colleges (19,4 %) also represented.

Table 1. Demographic Profile of Respondents

Demographic Variables	Categories	Frequency	Percentage
Gender	Male	234	56,8 %
	Female	172	41,7 %
	Non-binary	6	1,5 %

Age	25-34 years	98	23,8 %
	35-44 years	147	35,7 %
	45-54 years	112	27,2 %
	55-64 years	48	11,7 %
	Above 65 years	7	1,7 %
Academic Rank	Assistant Professor	168	40,8 %
	Associate Professor	142	34,5 %
	Full Professor	87	21,1 %
	Lecturer/Instructor	15	3,6 %
Discipline	STEM	156	37,9 %
	Social Sciences	98	23,8 %
	Humanities	72	17,5 %
	Business/ Professional	86	20,9 %
Institution Type	Research University	198	48,1 %
	Teaching College	134	32,5 %
	Community College	80	19,4 %
Teaching Experience	1-5 years	89	21,6 %
	6-10 years	134	32,5 %
	11-20 years	142	34,5 %
	Over 20 years	47	11,4 %

Measurement Model Assessment

The measurement model demonstrated excellent psychometric properties. All constructs showed Cronbach's alpha values exceeding 0,90 (range: 0,906-0,930), well above the 0,70 threshold, indicating high internal consistency reliability. Composite Reliability (CR) values ranged from 0,928 to 0,951, further confirming reliability.

Convergent validity was established as all Average Variance Extracted (AVE) values exceeded 0,70 (range: 0,705-0,830), surpassing the minimum threshold of 0,50. All outer loadings exceeded 0,79, with most above 0,80, demonstrating strong indicator reliability. These values confirm that each construct adequately explains the variance in its indicators.

Table 2 presents the measurement model assessment results, including factor loadings, reliability coefficients, and validity measures.

Discriminant validity was confirmed through two methods. First, the Fornell-Larcker criterion (table 3) showed that the square root of each construct's AVE (diagonal elements) exceeded its correlations with other constructs (off-diagonal elements). Second, all HTMT ratios were below 0,85 (ranging from 0,538 to 0,798), meeting the conservative threshold and confirming that constructs are empirically distinct. Table 3 presents the discriminant validity assessment using the Fornell-Larcker criterion.

Table 2. Measurement Model Assessment

Variables	Items	Statements	Outer Loading	Composite Reliability	AVE	Cronbach's Alpha
AI Literacy	AIL14.2 Measurement Model Assessment	I actively seek to learn about AI applications in education	0,874	0,934	0,705	0,916
	AIL2	I regularly use AI tools in my teaching practice	0,798			
	AIL3	I understand the capabilities and limitations of AI technologies	0,843			
	AIL4	I can evaluate the quality of AI-generated content	0,856			
	AIL5	I integrate AI tools effectively into my courses	0,832			
	AIL6	I stay updated on AI developments relevant to education	0,862			

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Digital Competencies	DC1	I effectively create and manage digital content for teaching	0,888	0,928	0,720	0,906
	DC2	I communicate effectively through digital platforms	0,821			
	DC3	I integrate various digital tools into my teaching practice	0,869			
	DC4	I evaluate digital resources for educational quality and relevance	0,834			
	DC5	I adapt my teaching to various digital environments	0,824			
Institutional Support	IS1	My institution provides adequate resources for technology integration	0,887	0,942	0,766	0,921
	IS2	Leadership actively supports faculty technology adoption	0,894			
	IS3	Professional development opportunities for technology are available	0,856			
	IS4	Technical support is readily accessible when needed	0,871			
	IS5	Institutional policies encourage technology innovation	0,885			
Technological Self-Efficacy	TSE1	I am confident in my ability to learn new technologies	0,916	0,951	0,830	0,930
	TSE2	I can effectively troubleshoot technology problems	0,889			
	TSE3	I feel comfortable adapting to new digital tools	0,924			
	TSE4	I can quickly master new technology applications	0,912			
Teaching Effectiveness	TE1	I effectively engage students in learning activities	0,863	0,939	0,721	0,921
	TE2	I create inclusive and supportive learning environments	0,847			
	TE3	I facilitate meaningful student learning experiences	0,878			
	TE4	I adapt my teaching to meet diverse student needs	0,821			
	TE5	I provide effective feedback to promote student growth	0,834			
	TE6	I achieve positive learning outcomes in my courses	0,856			
Professional Development Readiness	PDR1	I actively seek opportunities for professional growth	0,894	0,945	0,773	0,926
	PDR2	I am motivated to learn new skills and competencies	0,889			
	PDR3	I embrace challenges as learning opportunities	0,871			
	PDR4	I engage in continuous improvement of my practice	0,883			
	PDR5	I am open to feedback and constructive criticism	0,867			

These comprehensive assessments confirm that the measurement model meets all required criteria for reliability, convergent validity, and discriminant validity, providing a solid foundation for structural model evaluation.

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Table 3. Fornell-Larcker Criterion						
Construct	**AIL**	**DC**	**IS**	**TSE**	**TE**	**PDR**
AI Literacy (AIL)	0,839					
Digital Competencies (DC)	0,673	0,848				
Institutional Support (IS)	0,587	0,625	0,875			
Technological Self-Efficacy (TSE)	0,719	0,698	0,634	0,911		
Teaching Effectiveness (TE)	0,684	0,712	0,539	0,612	0,849	
Professional Development Readiness (PDR)	0,692	0,735	0,598	0,687	0,789	0,879

Structural Model Assessment

The structural model demonstrated strong explanatory power with R^2 values of 0,681 for Teaching Effectiveness and 0,743 for Professional Development Readiness. These values indicate that the model explains 68,1 % of the variance in teaching effectiveness and 74,3 % of the variance in professional development readiness, representing substantial explanatory power.

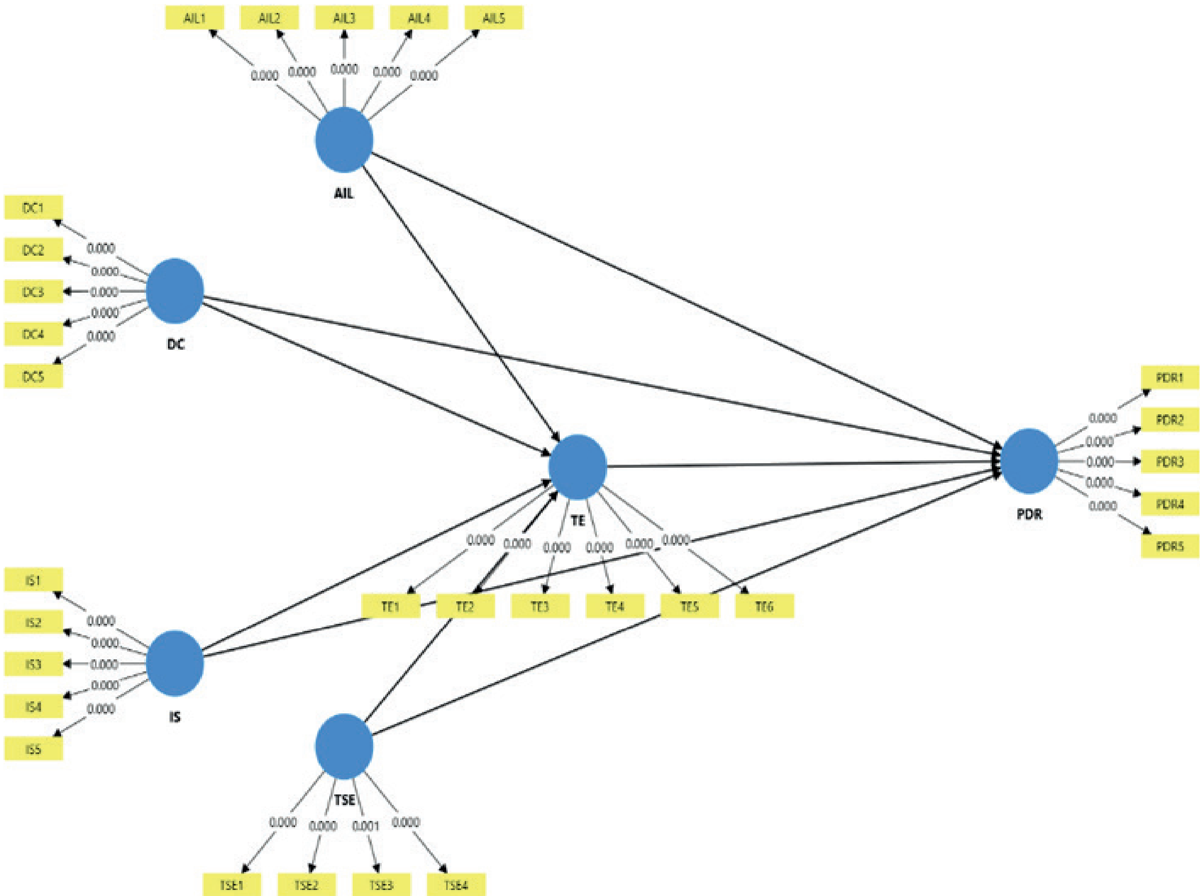

Figure 2. Structural Model

Table 4 summarizes the hypothesis testing results for direct effects.

Table 4. Results of Hypothesis Testing - Direct Effects						
Hypothesis	**Relationship**	**Path Coefficient**	**t-value**	**p-value**	**f²**	**Decision**
H1	AI Literacy → Teaching Effectiveness	0,298	6,847	0,000	0,095	Supported
H2	Digital Competencies → Teaching Effectiveness	0,324	7,692	0,000	0,118	Supported
H3	Institutional Support → Teaching Effectiveness	0,185	4,123	0,000	0,041	Supported
H4	Technological Self-Efficacy → Teaching Effectiveness	0,203	4,876	0,000	0,048	Supported

H5	AI Literacy → Professional Development Readiness	0,142	3,254	0,001	0,024	Supported
H6	Digital Competencies → Professional Development Readiness	0,178	4,187	0,000	0,035	Supported
H7	Institutional Support → Professional Development Readiness	0,126	2,987	0,003	0,019	Supported
H8	Technological Self-Efficacy → Professional Development Readiness	0,134	3,156	0,002	0,021	Supported
H9	Teaching Effectiveness → Professional Development Readiness	0,487	11,254	0,000	0,194	Supported

Table 4 summarizes the hypothesis testing results. All direct effects were statistically significant ($p < 0,01$). Digital competencies showed the strongest effect on teaching effectiveness ($ß = 0,324$, $t = 7,692$), followed by AI literacy ($ß = 0,298$, $t = 6,847$), technological self-efficacy ($ß = 0,203$, $t = 4,876$), and institutional support ($ß = 0,185$, $t = 4,123$). Teaching effectiveness demonstrated the strongest effect on professional development readiness ($ß = 0,487$, $t = 11,254$). Effect sizes (f^2) ranged from small to medium, with teaching effectiveness showing a medium-to-large effect on professional development readiness ($f^2 = 0,194$).

Mediation Analysis

Table 5 presents the mediation analysis results examining teaching effectiveness as a mediator.

Table 5. Mediation Analysis Results

Mediating Path	Direct Effect	Indirect Effect	Total Effect	VAF	Mediation Type
AIL → TE → PDR	0,142*	0,145*	0,287*	50,5 %	Partial Mediation
DC → TE → PDR	0,178*	0,158*	0,336*	47,0 %	Partial Mediation
IS → TE → PDR	0,126*	0,090*	0,216*	41,7 %	Partial Mediation
TSE → TE → PDR	0,134*	0,099*	0,233*	42,5 %	Partial Mediation

Note: AIL = AI Literacy; DC = Digital Competencies; IS = Institutional Support; TSE = Technological Self-Efficacy; TE = Teaching Effectiveness; PDR = Professional Development Readiness; VAF = Variance Accounted For; $p < 0,001$

The mediation analysis revealed that teaching effectiveness partially mediates all relationships between the independent variables and professional development readiness. All direct effects remained significant even after accounting for the indirect effects through teaching effectiveness, indicating partial rather than full mediation. Variance Accounted For (VAF) values ranged from 41,7 % to 50,5 %, with AI literacy showing the highest mediation effect (VAF = 50,5 %), followed by digital competencies (47,0 %), technological self-efficacy (42,5 %), and institutional support (41,7 %).

DISCUSSION

This study investigated the associations between AI literacy, digital competencies, institutional support, technological self-efficacy, teaching effectiveness, and professional development readiness among higher education faculty. The findings reveal important insights about how technological and contextual factors influence faculty professional development through teaching quality.

Key Findings and Theoretical Implications

All independent variables significantly influenced teaching effectiveness, with digital competencies showing the strongest effect ($ß = 0,324$), followed by AI literacy ($ß = 0,298$), technological self-efficacy ($ß = 0,203$), and institutional support ($ß = 0,185$). These findings align with previous research highlighting the importance of comprehensive digital skills for effective teaching, while extending this work by demonstrating the relative contributions of different technological competencies.[28,29] The particularly strong effect of digital competencies suggests that broad technological proficiency may be more fundamental to teaching quality than specialized AI knowledge, though both contribute meaningfully to pedagogical success.

These results extend the Technology Acceptance Model (TAM) by demonstrating that both capability-related factors (AI literacy, digital competencies, technological self-efficacy) and contextual factors (institutional support) influence educational outcomes. While TAM traditionally focuses on technology adoption intentions, our findings show how these factors translate into actual teaching effectiveness, providing empirical support for TAM's applicability beyond adoption to implementation quality.

The direct effects of all independent variables on professional development readiness confirm prior research suggesting that technological competencies and supportive contexts motivate faculty professional growth.[30,31,32,33,34,35] However, the relatively modest effect sizes of these direct relationships (β ranging from 0,126 to 0,178) compared to the strong effect of teaching effectiveness on professional development readiness (β = 0,487) suggest something important: technological competencies and institutional support influence professional development motivation primarily through their impact on teaching success rather than directly.

This finding significantly extends Self-Determination Theory (SDT) in the educational technology context. SDT posits that competence satisfaction drives intrinsic motivation. Our results demonstrate this mechanism empirically—successful teaching experiences (representing competence satisfaction) strongly fuel motivation for further professional development. Faculty who achieve positive outcomes through technology integration experience competence fulfillment, which then motivates continued learning and growth. This aligns with SDT's emphasis on competence as a fundamental psychological need driving sustained behavioral change.[19,20]

The mediation analysis provides perhaps the most theoretically significant contribution. Teaching effectiveness partially mediated all relationships between independent variables and professional development readiness, with VAF values ranging from 41,7 % to 50,5 %. This indicates that roughly half of the influence of technological competencies and institutional support on professional development readiness operates through enhanced teaching quality, while the other half represents direct effects.

This dual-pathway model reconciles seemingly contradictory findings in previous literature. Some studies have found direct relationships between technological competencies and professional development engagement.[33,34] while others have emphasized the mediating role of successful implementation experiences.[13] Our findings demonstrate that both pathways exist simultaneously, with teaching effectiveness serving as a crucial but partial mediator.

Comparison with Previous Research

Our findings largely align with but also extend previous research. The positive relationship between digital competencies and teaching effectiveness (β = 0,324) is consistent with Kumar and Singh's meta-analytic findings, though our effect size is somewhat larger, possibly reflecting the increasingly central role of digital technologies in contemporary higher education.[14] Similarly, the AI literacy-teaching effectiveness relationship (β = 0,298) supports recent work by Chen et al. while providing more precise quantification of this effect.[36]

One somewhat surprising finding is the relatively weaker direct effect of institutional support on both teaching effectiveness (β = 0,185) and professional development readiness (β = 0,126) compared to individual-level factors. This contrasts with some previous research emphasizing organizational factors as primary drivers of technology adoption.[24,26] This discrepancy might reflect a shift in the digital transformation landscape as technologies become more user-friendly and ubiquitous, individual competencies and self-efficacy may matter more than institutional infrastructure. Alternatively, it might indicate that institutional support operates more as an enabling condition (necessary but not sufficient) rather than as a primary driver of teaching effectiveness.[37,38,39]

The strong mediating role of teaching effectiveness represents a novel empirical contribution. While researchers have theorized about this mechanism, few studies have explicitly tested it with comprehensive mediation analysis.[13,40] Our VAF values (41,7 %-50,5 %) are substantially higher than those reported in related educational technology research, suggesting that teaching effectiveness may be particularly important in translating technological competencies into sustained professional development motivation in higher education contexts.[41,42]

Practical Implications

For higher education administrators, these findings emphasize the need for comprehensive approaches to faculty development that address multiple dimensions simultaneously. Simply providing technological infrastructure (institutional support) appears insufficient; institutions must also invest in developing faculty AI literacy, digital competencies, and technological self-efficacy. The strong mediating role of teaching effectiveness suggests that professional development programs should emphasize practical applications and immediate benefits for teaching practice rather than technology for its own sake.

For faculty development professionals, the findings suggest that programs helping faculty achieve successful teaching outcomes through technology integration may naturally lead to increased motivation for continued professional development, creating a virtuous cycle. This implies that initial professional development efforts should focus on building foundational competencies that enable quick wins in teaching practice, thereby building both competence and motivation for deeper engagement.

For individual faculty, the results suggest that developing comprehensive technological competencies—

particularly broad digital skills alongside specialized AI knowledge—can enhance both teaching effectiveness and motivation for professional growth. The positive feedback loop identified in this study suggests that initial investments in skill development yield compounding returns through improved teaching and increased motivation for continued learning.

Limitations and Future Directions

Several limitations should be acknowledged. First, the cross-sectional design limits causal inferences. While theoretical frameworks and previous research support the directional relationships proposed, longitudinal studies are needed to establish temporal precedence and examine how these relationships evolve over time. Future research should track faculty as they develop technological competencies to understand whether changes in independent variables genuinely precede changes in teaching effectiveness and professional development readiness.

Second, reliance on self-reported measures may introduce common method bias, though Harman's single-factor test suggested this was not a major concern. Future research should incorporate objective measures of teaching effectiveness (e.g., student learning outcomes, peer observations) and actual professional development participation to validate these findings.

Third, the study focused on general constructs without examining specific technologies or professional development activities. The relationships identified might vary depending on which particular AI tools are being used or which types of professional development are being pursued. Future research should investigate whether different categories of AI applications (e.g., automated assessment vs. personalized learning systems) or professional development formats (e.g., formal courses vs. informal communities of practice) show different patterns of relationships.

Fourth, the sample, while diverse, was drawn from a specific geographic and temporal context. The rapid evolution of AI technologies means these relationships might change as technologies mature and become more integrated into standard practice. Cross-cultural studies and repeated cross-sectional studies could illuminate how these relationships vary across contexts and over time.

Finally, while the model explained substantial variance (R^2 = 0,743 for professional development readiness), other potentially important factors were not examined. Individual factors like growth mindset, prior technology experiences, or disciplinary norms, as well as contextual factors like peer support or student characteristics, might also influence these relationships. Future research should develop more comprehensive models incorporating additional predictors and potential moderators.

CONCLUSION

This research investigated how AI literacy, digital competencies, institutional support, and technological self-efficacy influence professional development readiness among higher education faculty, with teaching effectiveness functioning as a mediating variable. The findings demonstrate that all four independent variables significantly influence both teaching effectiveness and professional development readiness, with teaching effectiveness serving as a partial mediator in these relationships.

The study makes several important contributions. First, it provides a comprehensive model examining multiple technical and contextual elements influencing professional development readiness, moving beyond single-factor studies to understand how various competencies work together. Second, it empirically demonstrates teaching effectiveness as a crucial mediating mechanism, enhancing understanding of how technical capabilities translate into professional growth motivation. Third, it extends both TAM and SDT by showing how technology-related factors influence sustained motivation through successful implementation experiences.

The findings suggest that comprehensive faculty development programs should simultaneously address multiple technological competencies while emphasizing practical teaching applications that enable faculty to experience success. This creates a positive feedback loop where improved teaching effectiveness motivates continued professional development, which further enhances technological competencies and teaching quality. Such an approach aligns with both theoretical frameworks and practical realities of faculty development in rapidly evolving digital environments.

As higher education continues its digital transformation, understanding the mechanisms linking technological competencies to sustained faculty development becomes increasingly important. This study provides evidence that teaching effectiveness serves as a vital bridge connecting technological skills with ongoing professional growth, offering a foundation for more effective faculty development strategies.

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CONFLICT OF INTEREST
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