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ORIGINAL ARTICLE

Online conferences and teachers' digital competence: Insights from a DigCompEdu study

Conferencias en línea y competencia digital docente: Perspectivas desde un estudio basado en DigCompEdu

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ABSTRACT
This study examines the role of online conference participation in enhancing university teachers' digital competence and its impact on teaching innovation and professional development. Guided by the DigCompEdu framework, the study investigates the relationships among conference engagement, institutional support, self-efficacy, digital competence, teaching innovation, and perceived professional impact. A quantitative cross-sectional design was employed with 500 in-service university teachers from public and private universities in Pakistan. Data was collected using a structured survey instrument and analyzed through Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), and Structural Equation Modeling (SEM). Multi-group SEM analysis was also conducted to examine differences between public and private universities. The results indicate that conference engagement (β = .29, p < .001), institutional support (β = .24, p < .001), and self-efficacy (β = .38, p < .001) significantly predict digital competence. In turn, digital competence strongly predicts teaching innovation (β = .71, p < .001) and perceived professional impact (β = .48, p < .001). Bootstrapping analysis further confirmed a significant indirect effect of conference engagement on professional impact through digital competence (β = .14, p < .001). The findings highlight the importance of institutional support and professional learning ecosystems in strengthening faculty digital competence and fostering sustainable digital transformation in universities.

Keywords: DigCompEdu; Digital competence; Online conferences, Higher education; Teaching innovation.

RESUMEN
Este estudio examina el papel de la participación en conferencias en línea en la mejora de la competencia digital de los docentes universitarios y su impacto en la innovación docente y el desarrollo profesional. Se empleó un diseño cuantitativo transversal con 500 docentes universitarios en activo de universidades públicas y privadas en Pakistán. Los datos se recopilaron mediante un instrumento de encuesta estructurado y se analizaron a través de Análisis Factorial Exploratorio (EFA), Análisis Factorial Confirmatorio (CFA) y Modelado de Ecuaciones Estructurales (SEM). También se realizó un análisis SEM multigrupo para examinar las diferencias entre universidades públicas y privadas. Los resultados indican que la participación en conferencias (β = .29, p < .001), el apoyo institucional (β = .24, p < .001) y la autoeficacia (β = .38, p < .001) predicen significativamente la competencia digital. A su vez, la competencia digital predice fuertemente la innovación docente (β = .71, p < .001) y el impacto profesional percibido (β = .48, p < .001). El análisis de bootstrapping confirmó además un efecto indirecto significativo de la participación en conferencias sobre el impacto profesional a través de la competencia digital (β = .14, p < .001). Los hallazgos destacan la importancia del apoyo institucional y de los ecosistemas de aprendizaje profesional para fortalecer la competencia digital del profesorado y fomentar una transformación digital sostenible en las universidades.

Palabras clave: DigCompEdu; Competencia digital; Conferencias en línea; Educación superior; Innovación docente.

INTRODUCTION

The digital transformation of higher education has accelerated dramatically over the past decade, reshaping institutional structures, pedagogical practices, and academic identities. While universities had already begun integrating learning management systems, blended learning models, and digital research tools prior to 2020, the COVID-19 pandemic acted as a catalytic force that compelled institutions worldwide to rapidly adopt fully online and hybrid modes of instruction (Crawford et al., 2020; Hodges et al., 2020).

This abrupt transition exposed both the potential and fragility of digital infrastructures in higher education systems. As universities moved beyond emergency remote teaching toward sustainable hybrid ecosystems, digital transformation became not merely a technological adjustment but a structural reconfiguration of teaching, learning, and scholarly engagement (Bond et al., 2018; Selwyn, 2021). Post-pandemic universities increasingly operate within hybrid models that blend face-to-face interaction with digital platforms, virtual collaboration spaces, and cloud-based research environments. These transformations extend beyond instructional delivery to encompass digital research, open science practices, online peer collaboration, and global academic networking (Weller, 2011; Veletsianos & Kimmons, 2012).

Digital research now involves activities such as virtual conference participation, collaborative research via digital platforms, dissemination through open-access repositories, and scholarly engagement through academic social networks. Consequently, university faculty members are expected not only to teach using digital technologies but also to participate in digitally mediated research communities. This dual expectation underscores the growing centrality of digital competence within contemporary academic work.

Within this broader digital shift, online conferences have emerged as significant academic ecosystems rather than mere substitutes for face-to-face meetings. Unlike traditional webinars that primarily deliver one-directional content, virtual conferences facilitate multidimensional interaction through live presentations, breakout sessions, digital poster exhibitions, collaborative workshops, and asynchronous networking tools (Skiles et al., 2022). These spaces enable knowledge exchange, interdisciplinary dialogue, and rapid dissemination of research findings across geographic boundaries. During and after the pandemic, online conferences demonstrated their capacity to maintain scholarly continuity while reducing financial, environmental, and logistical barriers to participation (Fraser et al., 2017; Niner & Wassermann, 2021).

Moreover, online academic events contribute to what may be described as professional capital formation within higher education. Participation in virtual conferences supports the development of professional learning networks, enhances research visibility, and strengthens institutional collaboration (Trust et al., 2016). The internationalization of higher education has also been reshaped through digital conferencing, allowing faculty members from resource-constrained institutions to access global scholarly communities without travel constraints. Such digital academic networking plays a critical role in sustaining research productivity and pedagogical innovation in increasingly interconnected academic environments. Therefore, online conferences function not only as professional development tools but also as strategic platforms for academic identity formation and knowledge circulation.

As higher education becomes increasingly digitized, university faculty digital competence has evolved into a multidimensional construct that integrates pedagogical, technological, and scholarly capabilities. The European Commission's DigCompEdu framework conceptualizes digital competence across six domains, emphasizing professional engagement, digital resources, teaching and learning, assessment, learner empowerment, and facilitating learners' digital competence (Redecker & Punie, 2017).

While initially developed with broad educational applicability, the framework has gained relevance in higher education contexts where faculty members must balance research obligations with innovative teaching practices. In universities, digital competence extends beyond classroom technology use to encompass the integration of research and teaching through digital means. Faculty members increasingly employ data visualization tools, simulation platforms, virtual laboratories, and collaborative research software to enrich student learning experiences (Bond et al., 2018).

Furthermore, pedagogical innovation in higher education often involves blended learning designs, flipped classrooms, adaptive assessment technologies, and digitally mediated student feedback systems. These innovations require not only technical fluency but also pedagogical intentionality and reflective practice (Koehler & Mishra, 2009; Selwyn, 2021). Thus, digital competence in the university context reflects a synthesis of academic research, instructional design expertise, and collaborative digital engagement.

Research gap

Despite the expanding literature on digital transformation and online professional development, significant gaps remain in understanding how online conferences specifically influence digital competence among university faculty. Much of the existing research focuses either on emergency remote teaching during the pandemic (Hodges et al., 2020) or on general online professional development models in K-12 settings (Trust & Whalen, 2020).

Empirical investigations into the structured impact of online academic conferences within higher education remain limited, particularly in large-scale, multi-institutional contexts. Furthermore, although the DigCompEdu

framework has been widely applied in European and school-based studies, its systematic application to university faculty development, especially in relation to conference participation, has received comparatively little empirical attention.

Existing studies often explore digital competence as an isolated construct rather than situating it within broader institutional ecosystems that include organizational support, academic culture, and research engagement. Consequently, there is a need for comprehensive empirical research that examines how participation in online conferences interacts with institutional support structures and individual self-efficacy to influence digital competence and professional impact in higher education settings. By integrating professional learning engagement, institutional conditions, and individual self-efficacy within a unified SEM framework, this study advances empirical understanding of how digital competence develops within contemporary higher education ecosystems.

Study objectives

1. To examine the impact of online conferences on university teachers' digital competence within the DigCompEdu framework.
2. To test the mediating role of digital competence in the relationship between conference engagement and perceived professional impact.
3. To assess differences in institutional support and digital competence between faculty members in public and private universities.
4. To analyze the predictive relationships among conference engagement, institutional support, self-efficacy, digital competence, teaching innovation, and professional impact using Structural Equation Modeling (SEM).

Literature review

Evolution of DigCompEdu in university settings

Digital competence has evolved from a narrow focus on technical ICT skills to a multidimensional construct encompassing pedagogical integration, professional collaboration, assessment innovation, and learner empowerment. The European Commission's DigCompEdu framework conceptualizes educator digital competence across six interconnected domains and has become one of the most widely referenced models for assessing digital capability in education (Redecker & Punie, 2017).

Although originally designed for broad educational application, DigCompEdu has increasingly been examined within higher education contexts, where faculty responsibilities extend beyond classroom teaching to include research dissemination, supervision, and institutional engagement. Recent studies indicate that university faculty digital competence is strongly associated with institutional digitalization strategies and pedagogical innovation (Bond et al., 2018; Rahmawati et al., 2024). In higher education, digital competence must accommodate complex teaching-research integration, interdisciplinary collaboration, and technology-enhanced scholarly communication.

As universities adopt blended and hybrid delivery systems, faculty members are required to demonstrate proficiency not only in instructional technologies but also in designing digitally enriched learning environments that support critical thinking and collaborative inquiry (Selwyn, 2021). Thus, the DigCompEdu framework provides a structured yet flexible lens through which university-level digital transformation can be analyzed.

Digital research represents an extension of academic practice into digitally networked environments. It includes open-access publishing, virtual collaboration, data sharing, digital content creation, and engagement through academic social networks (Veletsianos & Kimmons, 2012; Weller, 2011). For university faculty, digital competence increasingly involves navigating these scholarly ecosystems while maintaining research productivity and teaching quality. The ability to disseminate research through digital platforms, participate in virtual symposia, and collaborate internationally has become central to academic identity formation in the 21st century.

Digital research also intersects with teaching practices. Faculty members who engage in digital research dissemination often integrate emerging knowledge and technological tools into their instructional strategies, thereby fostering research-informed teaching. This convergence reinforces the need to conceptualize digital competence as both pedagogical and scholarly rather than purely technical.

Blended and hybrid pedagogies

Blended and hybrid pedagogies have become defining features of post-pandemic higher education. Blended learning combines online and face-to-face instructional components to enhance flexibility and learner engagement (Garrison & Kanuka, 2004). Research consistently demonstrates that well-designed blended environments can improve student outcomes and promote deeper learning when pedagogically aligned (Bernard et al., 2014). However, effective implementation depends heavily on faculty digital competence, instructional design skills, and confidence in technology integration. Hybrid university models require faculty to redesign assessment practices, manage virtual collaboration, and employ digital analytics to monitor student progress.

Consequently, digital competence in higher education is increasingly viewed as foundational to teaching innovation and institutional resilience.

Online professional development (OPD) in universities has expanded significantly, particularly through virtual academic conferences. Unlike traditional workshops, virtual conferences create dynamic environments for synchronous and asynchronous interaction, enabling broader participation and reducing financial and geographical barriers (Fraser et al., 2017; Skiles et al., 2022). These platforms facilitate scholarly exchange, peer feedback, interdisciplinary networking, and exposure to emerging pedagogical tools.

Virtual conferences have also been recognized for their environmental and equity advantages, promoting inclusion of scholars from under-resourced institutions and regions (Niner & Wassermann, 2021). In higher education, participation in online conferences can enhance digital confidence, expand professional networks, and support pedagogical experimentation. Nevertheless, empirical investigations into how conference participation specifically enhances faculty digital competence remain limited.

Professional learning networks (PLNs) refer to digitally mediated communities where educators share resources, exchange ideas, and collaborate across institutional boundaries. Trust et al. (2016) demonstrate that PLNs significantly enhance professional growth by fostering collective knowledge-building and reflective practice. In higher education, faculty engagement in online networks, often initiated through conferences, can stimulate innovation in both teaching and research. Digital PLNs contribute to sustained learning beyond single events, supporting ongoing professional dialogue. Such networks strengthen collaborative capital and enhance institutional knowledge-sharing capacity.

Knowledge-sharing ecosystems

Higher education institutions increasingly function as knowledge-sharing ecosystems supported by digital platforms. Networked research enables rapid dissemination of research outputs and pedagogical innovations (Veletsianos & Kimmons, 2012). Conferences, webinars, and collaborative digital spaces collectively create interconnected academic ecosystems that extend beyond institutional boundaries. Within these ecosystems, digital competence facilitates meaningful participation. Faculty members who possess higher digital competence are more likely to engage in knowledge exchange, adopt innovative practices, and integrate external insights into their teaching.

Institutional infrastructure plays a critical role in shaping digital competence development. Access to reliable internet connectivity, learning management systems, digital libraries, and technical support directly influences faculty engagement with technology-enhanced teaching (Bond et al., 2018). Insufficient infrastructure can constrain innovation and limit the effectiveness of professional development initiatives. Leadership support and strategic vision significantly influence digital transformation outcomes in higher education. Institutional leaders who prioritize digital innovation, allocate resources, and encourage experimentation create enabling environments for faculty development (Selwyn, 2021).

Organizational commitment to digital integration fosters a culture of professional growth and reduces resistance to technological change. An innovation-supportive climate encourages risk-taking, collaboration, and continuous learning. Research in organizational behavior indicates that innovation climates are associated with higher levels of knowledge sharing and creative performance (Scott & Bruce, 1994). In universities, such climates promote the adoption of blended pedagogies and active engagement in professional development activities, including online conferences.

Self-efficacy, defined as an individual's belief in their capability to execute specific tasks (Bandura, 1997), is a strong predictor of technology adoption and pedagogical innovation. Faculty members with higher digital self-efficacy are more likely to experiment with blended teaching, integrate new tools, and persist in overcoming technological challenges (Tschannen-Moran & Hoy, 2001). Confidence in digital teaching enhances both perceived competence and professional satisfaction. Conversely, low self-efficacy may hinder engagement in online professional development activities.

University faculty typically operate within high-autonomy professional cultures. Academic identity is shaped by disciplinary expertise, research productivity, and pedagogical philosophy. Digital transformation can challenge traditional academic identities by introducing new expectations regarding technology integration and online engagement (Weller, 2011). Faculty who perceive digital tools as aligned with their scholarly identity are more likely to integrate them meaningfully into teaching and research.

Hypotheses development

Drawing from the reviewed literature, this study proposes a structured model linking conference engagement, institutional support, and self-efficacy to digital competence and professional outcomes.

1. H1: Conference engagement, institutional support, and self-efficacy positively predict digital competence.
2. H2: Digital competence positively predicts professional impact.

3. H3: Digital competence mediates the relationship between conference engagement and professional impact.
4. H4: Significant differences exist between public and private universities in structural relationships.
5. H5: Digital competence positively predicts teaching innovation.
6. H6: Teaching innovation positively predicts professional impact.

Theoretical Framework for digital competence in higher education

This study is theoretically grounded in the Digital Competence Framework for Educators (DigCompEdu) proposed by Redecker and Punie (2017), which conceptualizes educator digital competence as a multidimensional construct encompassing professional engagement, digital resources, teaching and learning, assessment, empowering learners, and facilitating learners' digital competence. In the context of higher education, this framework is adapted to reflect the expanded roles of university faculty, whose responsibilities integrate teaching, research, scholarly communication, and academic networking within digitally mediated environments. Digital competence is therefore positioned as a latent construct that reflects not only technological proficiency but also pedagogical intentionality, reflective practice, and participation in digital academic ecosystems.

Building upon social cognitive theory (Bandura, 1997), the model further incorporates self-efficacy as a critical individual determinant influencing the development and application of digital competence. In addition, institutional support, manifested through infrastructure, leadership commitment, and innovation climate, is conceptualized as a structural enabler of digital transformation within universities. Conference engagement is introduced as a professional development mechanism that exposes faculty to emerging pedagogies, digital tools, and collaborative networks.

The proposed framework assumes that these individual and institutional factors interact to shape digital competence, which in turn enhances teaching innovation and perceived professional impact. By positioning digital competence as a mediating mechanism, the model explains how participation in online academic conferences translates into meaningful pedagogical and professional outcomes. This integrated theoretical perspective extends DigCompEdu beyond descriptive assessment toward an explanatory model suitable for examining digital transformation processes in contemporary higher education.

Figure 1 illustrates the proposed structural model in which Conference Engagement, Institutional Support, and Self-Efficacy function as antecedents of Digital Competence, conceptualized through the six DigCompEdu domains. Digital Competence acts as a central mediating construct that influences Teaching Innovation and Perceived Professional Impact, highlighting its pivotal role in translating professional engagement and institutional conditions into meaningful academic outcomes

METHODOLOGY

Research design

This study employed a cross-sectional quantitative research design to examine the structural relationships among conference engagement, institutional support, self-efficacy, digital competence, teaching innovation, and perceived professional impact among university faculty. A cross-sectional survey design is appropriate for analyzing relationships among latent constructs at a single point in time and is widely used in educational research to investigate predictive and mediational models (Bryman, 2016; Creswell & Creswell, 2017). The study involved multi-university participation to enhance representativeness and increase generalizability across institutional contexts. By collecting data from faculty across different higher education institutions, the design enabled comparisons between public and private universities and facilitated testing of structural invariance across groups.

Population and sampling

The target population consisted of in-service university teachers employed in accredited public and private universities in Pakistan. A total sample of 500 faculty members participated in the study, with approximately 60% drawn from public universities and 40% from private universities. This proportional distribution reflects the structural composition of the higher education sector and enables meaningful comparative analysis.

A stratified cluster sampling technique was employed to ensure representation across institutional types and academic disciplines. Stratified sampling improves parameter estimation accuracy by ensuring proportional inclusion of relevant subgroups within heterogeneous populations (Etikan & Bala, 2017). Universities were first categorized by sector (public/private), after which faculty clusters were randomly selected within institutions. This approach increased external validity and minimized sampling bias.

Instrumentation

Data was collected using a structured questionnaire consisting of 45 items measured on a 7-point Likert scale ranging from 1 (Strongly Disagree) to 7 (Strongly Agree). A 7-point scale was selected to enhance response variability and improve measurement sensitivity in structural modeling (Kline, 2023).

The instrument was organized into six sections: (1) Conference Engagement, assessing faculty participation and interaction in online conferences; (2) Institutional Support, measuring perceived infrastructure, leadership encouragement, and innovation climate; (3) Self-Efficacy, assessing confidence in digital teaching capabilities; (4) Digital Competence, operationalized through the six DigCompEdu domains (Redecker & Punie, 2017); (5) Teaching Innovation, evaluating adoption of blended and technology-enhanced pedagogies; and (6) Perceived Professional Impact, capturing perceived professional growth and academic development resulting from conference participation. Items were adapted from validated instruments in prior studies on digital competence and teacher efficacy to ensure construct validity.

Validity and reliability

To ensure content validity, the instrument was reviewed by three experts in higher education, educational technology, and research methodology. Feedback was incorporated to refine wording clarity and contextual relevance. Construct validity was established through a two-step factor analytic approach. First, Exploratory Factor Analysis (EFA) was conducted to examine underlying factor structures and assess item loadings. EFA is recommended in the early stages of scale validation to identify latent dimensions (Hair Jr et al., 2010).

Subsequently, Confirmatory Factor Analysis (CFA) was performed using Structural Equation Modeling procedures to validate the measurement model and assess goodness-of-fit indices (Kline, 2023). Internal consistency reliability was assessed using Cronbach's alpha coefficients, with values exceeding .88 considered acceptable for established constructs (Hair Jr et al., 2010). Additionally, Composite Reliability (CR) and Average Variance Extracted (AVE) were calculated to assess convergent validity. CR values above .70 and AVE values above .50 indicate satisfactory construct reliability and convergent validity (Fornell & Larcker, 1981).

Data collection procedure

Data was collected through an online survey distributed via institutional email lists and faculty professional networks. Participation invitations included a brief description of the study's purpose, assurances of confidentiality, and an informed consent statement. The survey remained open for four weeks, with reminder notifications sent at two-week intervals to increase response rates. Participation was voluntary, and no financial incentives were offered. Completed responses were screened for missing data and response inconsistencies prior to analysis.

Data analysis

Data analysis was conducted using SPSS and AMOS. Descriptive statistics, including means and standard deviations, were computed to summarize faculty perceptions across all constructs. Independent samples t-tests were performed to examine differences between public and private university faculty. Pearson correlation analysis was conducted to assess associations among variables.

Multiple regression analysis was used to examine predictive relationships among independent and dependent variables prior to structural modeling. Structural Equation Modeling (SEM) was then employed to test the hypothesized path model, as SEM allows for simultaneous examination of multiple relationships among latent constructs and mediating effects (Kline, 2023). Model fit was evaluated using commonly recommended indices, including x^2/df, CFI, TLI, RMSEA, and SRMR. Finally, multi-group SEM analysis was conducted to compare structural relationships between public and private universities and assess potential group invariance.

Ethical considerations

The study adhered to established ethical standards in educational research. Ethical approval was obtained from the relevant institutional research ethics committee prior to data collection. Participants were informed

about the voluntary nature of the study, their right to withdraw at any time, and the confidentiality of their responses. No personally identifiable information was collected. Data were stored securely in encrypted digital files accessible only to the principal investigators. Ethical practices were guided by established principles of research integrity, confidentiality, and informed consent (Creswell & Creswell, 2017).

RESULTS

The sample reflects balanced gender representation and proportional inclusion of public and private university faculty in Table 1. Most participants had 6–10 years of experience, indicating mid-career representation. Academic ranks were diverse, enhancing the generalizability of findings across professional levels.

Table 1. Demographic characteristics of respondents (N = 500).

Variable	Category	Frequency	Percentage
Gender	Male	268	53.6%
	Female	232	46.4%
University Type	Public	300	60.0%
	Private	200	40.0%
Teaching Experience	1-5 years	130	26.0%
	6-10 years	190	38.0%
	11-15 years	110	22.0%
	16+ years	70	14.0%
Academic Rank	Lecturer	210	42.0%
	Assistant Professor	165	33.0%
	Associate Professor	85	17.0%
	Professor	40	8.0%

All constructs in Table 2 demonstrate relatively high mean scores, indicating positive perceptions among university faculty. Professional Impact recorded the highest mean, suggesting that faculty perceive meaningful professional benefits from conference participation. Variability levels indicate acceptable dispersion without extreme skewness.

Table 2. Descriptive statistics of study constructs.

Construct	Mean (M)	SD
Conference Engagement	5.42	0.88
Institutional Support	5.18	0.91
Self-Efficacy	5.36	0.84
Digital Competence	5.29	0.79
Teaching Innovation	5.33	0.82
Professional Impact	5.47	0.76

Measurement model (CFA results)

Factor loadings

Table 3 demonstrates that all standardized factor loadings ranged between 0.71 and 0.89, exceeding the recommended threshold of 0.70. The confirmatory factor analysis also demonstrated an acceptable measurement model fit. The model fit indices met recommended thresholds, including $x^2/df = 2.18$, Comparative Fit Index (CFI) = 0.95, and Root Mean Square Error of Approximation (RMSEA) = 0.046, indicating a good fit between the measurement model and the observed data.

Table 3. Reliability and convergent validity.

Construct	CR	AVE
Conference Engagement	0.91	0.63
Institutional Support	0.90	0.60
Self-Efficacy	0.92	0.66
Digital Competence	0.94	0.68
Teaching Innovation	0.90	0.64
Professional Impact	0.93	0.69

Discriminant validity was confirmed, as the square root of the AVE for each construct exceeded the inter-construct correlations.

The CFA results demonstrate strong measurement validity. CR values exceed 0.90 and AVE values are above 0.50, confirming convergent validity. Discriminant validity criteria were satisfied, indicating that constructs are empirically distinct.

Group differences (public vs private universities)

Private university faculty reported significantly higher levels of institutional support, digital competence, and teaching innovation see Table 4. These findings suggest that the institutional environment plays a substantial role in facilitating digital development.

Table 4. Independent samples t-test.

Construct	Public (M)	Private (M)	t	p
Institutional Support	4.98	5.49	-6.42	< .001
Digital Competence	5.18	5.45	-3.87	< .001
Teaching Innovation	5.21	5.51	-3.94	< .001

Note. ns = not significant; p < .05 considered statistically significant.

The Pearson correlation results in Table 5 indicate significant positive relationships among all study variables. Conference engagement, institutional support, and self-efficacy are moderately correlated with digital competence, suggesting that higher engagement, support, and confidence are associated with stronger digital skills. Digital competence shows strong correlations with teaching innovation and professional impact, indicating that educators with higher digital competence are more likely to adopt innovative teaching practices and experience greater professional development.

Table 5. Pearson correlation.

Variable	1	2	3	4	5	6
1. Conf. Engagement	1					
2. Inst. Support	.48***	1				
3. Self-Efficacy	.52***	.46***	1			
4. Digital Competence	.63	.58	.66	1		
5. Teaching Innovation	.55	.49	.61	.72	1	
6. Professional Impact	.59	.51	.57	.74	.70	1

All correlations significant at ***p < .001.

The model in Table 6 explains 61% of the variance in digital competence. Self-efficacy emerged as the strongest predictor, followed by conference engagement and institutional support. These findings highlight the combined influence of individual and organizational factors.

Slight variations between regression and SEM coefficients are expected because SEM simultaneously estimates relationships among latent constructs while accounting for measurement error.

Table 6. Multiple regression predicting digital competence.

Predictor	β	t	p
Conference Engagement	.31	7.82	< .001
Institutional Support	.26	6.41	< .001
Self-Efficacy	.39	9.88	< .001

Model Summary: $R^2 = .61$, $F(3,496) = 259.44$, $p < .001$

Table 7 presents the tested structural model examining the relationships among Conference Engagement, Institutional Support, Self-Efficacy, Digital Competence, Teaching Innovation, and Professional Impact. Standardized path coefficients (β) are displayed along the arrows. Digital Competence significantly predicts Teaching Innovation (β = .71, p < .001) and Professional Impact (β = .48, p < .001), while Teaching Innovation further predicts Professional Impact (β = .32, p < .001). Conference Engagement (β = .29, p < .001), Institutional Support (β = .24, p < .001), and Self-Efficacy (β = .38, p < .001) significantly predict Digital Competence. The indirect effect of Conference Engagement on Professional Impact via Digital Competence is also significant (β = .14, p < .001).

Table 7. Structural model results.

Path	β	p
Conference Engagement → Digital Competence	.29	< .001
Institutional Support → Digital Competence	.24	< .001
Self-Efficacy → Digital Competence	.38	< .001
Digital Competence → Teaching Innovation	.71	< .001
Digital Competence → Professional Impact	.48	< .001
Teaching Innovation → Professional Impact	.32	< .001

Mediation analysis (bootstrapping, 5,000 samples) confirmed significant indirect effects of Conference Engagement on Professional Impact via Digital Competence (β = .14, p < .001).

Model fit indices indicate excellent fit: $x^2(96) = 214.76$, $x^2/df = 2.24$, CFI = 0.96, TLI = 0.95, RMSEA = 0.049, SRMR = 0.041 (Figure 2):

Model Fit Indices
$x^2 = 214.76$
df = 96
$x^2/df = 2.24$
CFI = 0.96
TLI = 0.95
RMSEA = 0.049
SRMR = 0.041

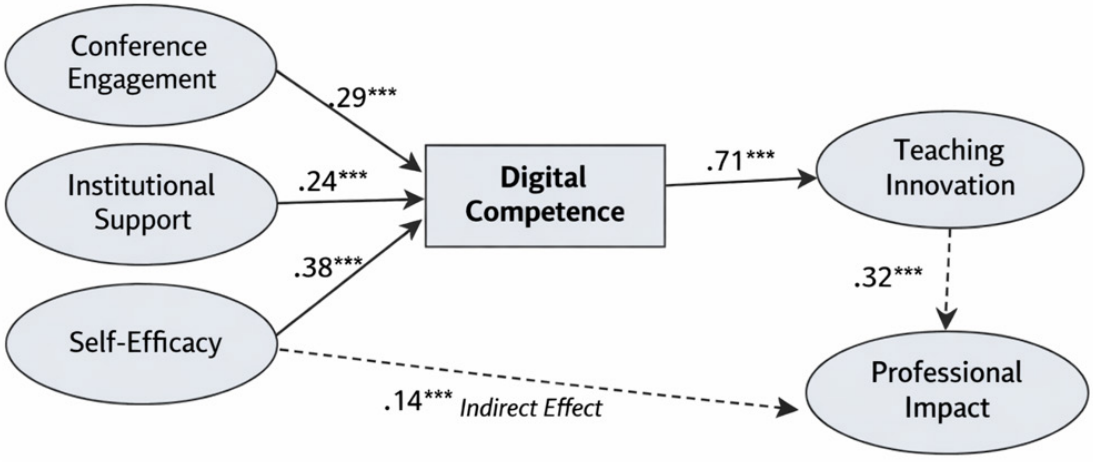


Figure 2. Structural equation model of digital competence, teaching innovation, and professional impact.

Multi-group SEM findings

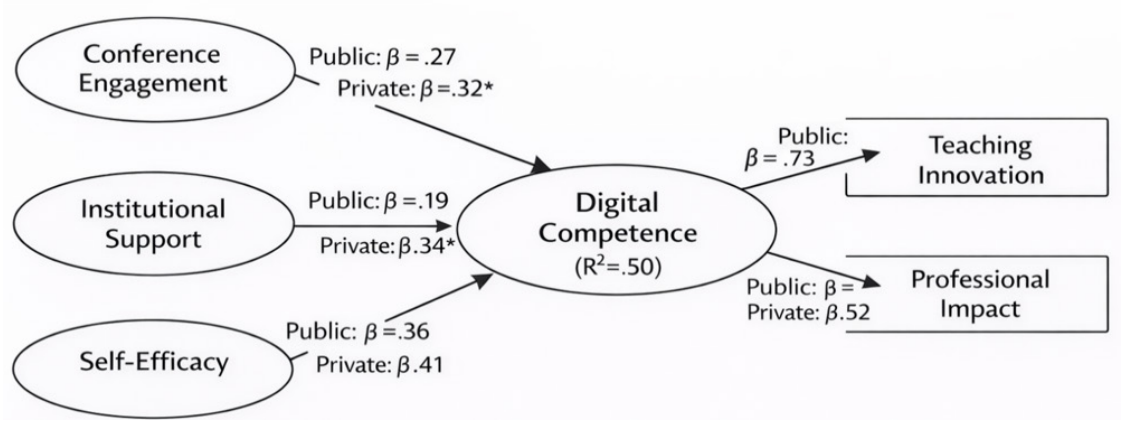
The multi-group SEM analysis in Table 8 indicates partial structural invariance across university sectors. While most structural paths did not differ significantly between public and private institutions, the relationship between Institutional Support and Digital Competence was significantly stronger in private universities.

Table 8. Multi-group SEM structural path comparison.

Path	Public (ß)	Private (ß)	Δx^2	p	Difference Significant?
Conference Engagement → Digital Competence	.27	.32	2.11	.146	No
Institutional Support → Digital Competence	.19	.34	6.87	.009	Yes
Self-Efficacy → Digital Competence	.36	.41	1.74	.187	No
Digital Competence → Teaching Innovation	.69	.73	1.02	.312	No
Digital Competence → Professional Impact	.46	.52	1.55	.213	No

A chi-square difference test (Δx^2) was conducted to assess structural invariance between public and private university groups.

This finding suggests that organizational infrastructure and leadership support play a more pronounced role in facilitating digital competence within private institutions (Figure 3).



DISCUSSION

The findings of this study highlight the central role of digital competence in shaping pedagogical innovation and professional development among university faculty. The structural model demonstrated that digital competence significantly predicts both teaching innovation and perceived professional impact, confirming its critical importance in contemporary higher education environments. As universities increasingly integrate digital technologies into teaching and research practices, faculty members are expected to possess not only technical skills but also the pedagogical capacity to effectively implement digital tools within learning environments. This aligns with the DigCompEdu framework proposed by Redecker and Punie (2017), which conceptualizes digital competence as a multidimensional construct encompassing professional engagement, digital resources, assessment strategies, and learner empowerment.

The strong relationship between digital competence and teaching innovation found in this study supports previous research indicating that educators with higher levels of digital competence are more likely to adopt innovative teaching strategies, including blended learning, digital collaboration tools, and interactive assessment methods (Bond et al., 2018). In university contexts, digital competence extends beyond classroom technology use to include research dissemination, academic networking, and participation in digital scholarly communities. These competencies enable faculty to create dynamic learning environments that foster student engagement and critical thinking. Consequently, strengthening digital competence among university teachers should be considered a strategic priority for higher education institutions seeking to enhance educational quality and innovation.

Role of institutional support

Institutional support emerged as a significant predictor of digital competence, underscoring the importance of organizational infrastructure and leadership in facilitating digital transformation in higher education.

Universities that provide robust technological infrastructure, professional development opportunities, and supportive leadership environments enable faculty to more effectively integrate digital technologies into teaching practices. The results suggest that institutional support functions as a foundational enabling factor that shapes faculty readiness and capacity to adopt digital innovations.

This finding is consistent with prior research emphasizing the role of institutional ecosystems in supporting digital transformation within higher education. Bond et al. (2018) argue that institutional policies, infrastructure, and professional learning opportunities significantly influence educators' willingness and ability to adopt digital technologies. Similarly, Selwyn (2021) highlights that digital transformation in universities is not solely a technological issue but also an organizational and cultural process that requires institutional commitment. When universities foster a supportive innovation climate, faculty members are more likely to experiment with new teaching approaches and integrate emerging technologies into their pedagogical practices. Therefore, institutional leadership and strategic investment in digital infrastructure remain essential for sustainable digital development in universities.

Conference engagement and academic innovation

The results further indicate that conference engagement positively influences digital competence, which subsequently enhances teaching innovation and professional impact. Participation in online academic conferences provides faculty with opportunities to engage in scholarly dialogue, exchange innovative practices, and gain exposure to emerging digital tools and pedagogical approaches. These professional development experiences contribute to the development of digital competence by enabling educators to learn from peers, explore new technological applications, and reflect on their own teaching practices.

Virtual conferences have become increasingly significant in the post-pandemic academic landscape, offering inclusive and accessible platforms for professional learning and knowledge exchange. Fraser et al. (2017) highlight that virtual conferences facilitate broader participation and enhance opportunities for interdisciplinary collaboration. Similarly, Skiles et al. (2022) demonstrate that online academic events expand access to global scholarly communities while reducing geographical and financial barriers. Through these digital professional development environments, faculty members can strengthen their digital skills, develop innovative teaching strategies, and expand their academic networks. The findings of this study therefore support the view that online conferences function as important professional learning ecosystems that contribute to faculty digital competence and innovation.

Public-private university differences

The multi-group analysis revealed notable differences between public and private universities, particularly regarding the influence of institutional support on digital competence. The relationship between institutional support and digital competence was stronger in private universities than in public institutions, suggesting that organizational context plays an important role in shaping digital transformation outcomes. Private universities often possess more flexible governance structures, enabling faster adoption of technological innovations and greater investment in digital infrastructure.

These findings are consistent with previous studies that have observed differences in organizational agility and resource allocation between public and private higher education institutions. Public universities frequently operate within complex bureaucratic systems that may slow the implementation of new technological initiatives (Selwyn, 2021).

In contrast, private universities often adopt market-oriented strategies that prioritize innovation and technological advancement to remain competitive. As a result, faculty in private institutions may experience stronger institutional encouragement and greater access to digital resources, facilitating the development of digital competence and innovative teaching practices. Nevertheless, the results also suggest that both sectors share similar structural relationships within the model, indicating that the fundamental mechanisms underlying digital competence development are consistent across institutional contexts.

Comparison with international higher education studies

The findings of this study align with international research examining digital competence and professional development in higher education. Studies conducted in European and global contexts have consistently emphasized the growing importance of digital competence for university faculty as institutions transition toward hybrid and digitally mediated learning environments (Bond et al., 2018; Rahmawati et al., 2024). Similar to the present study, these investigations report strong relationships between digital competence, pedagogical innovation, and professional development outcomes.

Moreover, the mediating role of digital competence observed in this study is consistent with broader theoretical perspectives on technology adoption in education. According to social cognitive theory (Bandura, 1997), individual capabilities and environmental conditions jointly influence behavioral outcomes. In the context

of higher education, professional learning opportunities such as conferences, combined with institutional support structures, contribute to the development of digital competence, which subsequently drives innovation in teaching practices. By integrating individual, institutional, and professional development factors within a unified structural model, the present study contributes to the growing body of international literature exploring digital transformation in higher education. It provides empirical evidence that professional learning ecosystems, such as online conferences, can play a significant role in strengthening faculty digital competence and fostering pedagogical innovation across universities.

IMPLICATIONS

The findings of this study have several important implications for higher education policy and institutional practice. At the policy level, higher education authorities such as the Higher Education Commission should prioritize national strategies that strengthen digital competence among university faculty through structured professional development initiatives, digital infrastructure investment, and incentives for technology-enhanced teaching.

At the institutional level, universities should develop comprehensive digital transformation strategies that include continuous training programs, technical support systems, and leadership initiatives that encourage faculty engagement with digital pedagogies and innovation. Furthermore, the results highlight the importance of designing effective online academic conferences as structured professional learning environments rather than passive webinar formats.

Universities and academic organizations should therefore develop interactive, collaborative, and research-oriented virtual conference models that facilitate knowledge exchange, digital skill development, and professional networking among faculty members. By aligning policy frameworks, institutional support systems, and professional learning opportunities, higher education institutions can more effectively enhance faculty digital competence and promote sustainable pedagogical innovation in digitally evolving academic environments.

LIMITATIONS

This study has several limitations that should be considered when interpreting the findings. First, a cross-sectional research design restricts the ability to establish causal relationships among the examined variables, as data is collected at a single point in time. Second, the use of self-reported measures may introduce response bias, as participants' perceptions may not fully reflect their actual digital practices. Future research should consider longitudinal designs to examine changes in faculty digital competence over time and to better understand the long-term effects of professional development activities such as online conferences. Additionally, future studies may benefit from adopting mixed-method approaches that combine quantitative analysis with qualitative insights to provide a deeper understanding of how institutional environments and professional learning experiences shape digital competence in higher education.

CONCLUSIONS

This study contributes to the growing body of literature on digital transformation in higher education by empirically examining the relationships between conference engagement, institutional support, self-efficacy, digital competence, and professional outcomes among university faculty. The findings provide a theoretical contribution by extending the application of the DigCompEdu framework within a higher education context and demonstrating the mediating role of digital competence in linking professional learning experiences with teaching innovation and professional impact.

From a practical perspective, the results highlight the importance of strengthening institutional support systems and promoting participation in online academic conferences as mechanisms for enhancing faculty digital competence. By integrating professional development opportunities with institutional digital strategies, universities can foster more dynamic digital ecosystems that support pedagogical innovation, collaborative knowledge sharing, and sustainable academic development in an increasingly technology-driven educational landscape. Future research should continue examining how digitally mediated professional learning ecosystems contribute to sustainable pedagogical innovation across diverse higher education contexts.

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Conflicts of Interest:

The authors declare no conflicts of interest.

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The authors were responsible for all aspects of the study, including conceptualization, methodology, analysis, and writing.

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