International Journal of Learning, Teaching and Educational Research
Vol. 24, No. 7, pp. 402-424, July 2025
https://doi.org/10.26803/ijlter.24.7.20
Received May 15, 2025; Revised Jun 25, 2025; Accepted Jul 4, 2025

Analyzing TPACK and Demographic Influences on Faculty Adoption of ChatGPT in Latin American Higher Education

Jorge David Ríos Gonzales*
Universidad Nacional de Trujillo
Av. Juan Pablo II, Trujillo, Perú

Janeth Tomanguilla Reyna
Universidad César Vallejo
Av. Larco 1770, Trujillo, Perú

Jorge Isaac Tarazona Pajuelo
Universidad Tecnológica del Perú
Av. Natalio Sanchez Nro. 125, Lima, Perú

Renzo Jesus Maldonado Gomez
Universidad Privada Antenor Orrego
Av. América Sur 3145, Trujillo, Perú

Annie Rosa Soto Zavaleta
Universidad Nacional del Santa
Av. Universitaria S/N, Nuevo Chimbote, Perú

Abstract. The rapid integration of generative artificial intelligence (AI) tools such as ChatGPT into higher education worldwide has created an urgent need for faculty to develop the necessary skills and knowledge to use these tools effectively and ethically. This study explores the way in which university faculty in Peru apply the Technological Pedagogical Content Knowledge (TPACK) framework when using ChatGPT for educational purposes. A cross-sectional survey of 180 instructors revealed that higher TPACK levels are moderately linked to more frequent and purposeful use of ChatGPT, although demographic factors such as gender, age, and prior AI training also play significant roles. The resultsults highlight that while TPACK provides a useful foundation, it may not fully predict how successfully faculty members will adopt generative AI, underscoring the need to expand this framework with AI-specific competencies. These findings offer practical insights for

*Corresponding author: *Jorge David Ríos Gonzales, jriosg@unitru.edu.pe*

designing faculty development programs and institutional policies that foster responsible and effective AI integration in higher education.

Keywords: ChatGPT; TPACK; artificial intelligence; digital pedagogy; higher education

1. Introduction

In the current era of digital transformation, the use of artificial intelligence (AI) has revolutionized multiple sectors, including education. One of the most influential tools is ChatGPT, a generative language model developed by OpenAI that enables information processing, coherent text production, and automated academic support. In higher education, integrating ChatGPT offers both opportunities and challenges in terms of developing key skills such as academic writing, inquiry, and creativity. The COVID-19 pandemic accelerated the adoption of digital technologies in universities, exposing not only access gaps but also deficiencies in digital skills among instructors and students (Chamorro-Atalaya et al., 2023; Medina et al., 2024). Although these skills are vital for autonomous learning and academic success, many students still struggle to develop them effectively without proper guidance on AI tools such as ChatGPT (Luciano, 2024; Mishra et al., 2023).

In Latin America, and especially in Peru, data reveal a persistent digital divide within higher education. According to the Ministry of Education (2024), over 70% of faculty lack the specific training needed to integrate emerging technologies such as ChatGPT into their teaching practice, while more than half of students lack sufficient skills to use digital tools for academic purposes. Structural barriers including limited connectivity, socioeconomic inequality, and insufficient methodological training exacerbate this situation (UNESCO, 2022; Castagnola Rossini et al., 2024).

Not only do these factors negatively impact academic productivity but they also hinder students' ability to actively engage in scientific and educational communities. Additionally, variables such as age, gender, and teaching workload may shape attitudes toward technology, widening the gap between technological innovation and academic performance (Medina et al., 2024).

Despite ChatGPT's potential to enhance idea generation, argument structuring, and academic writing, concerns have emerged regarding academic integrity, declining critical thinking skills, and potential cognitive dependency on AI-generated content. Scholars argue that the pedagogically guided use of ChatGPT can support critical thinking and argumentation when paired with appropriate instructional strategies (Banihashem et al., 2024; Medina et al., 2024); however, its unguided use may lead to superficial learning and reduced intellectual effort (Rasul et al., 2023; Dergaa et al., 2023).

Consequently, the educational community remains divided between advocates for responsible integration and proponents of restrictive measures to mitigate the risks of plagiarism or unverified content (Adiguzel et al., 2023). While some universities promote the use of AI as a learning tool, others enforce restrictive policies that limit their pedagogical potential (Almulla & Ali, 2024).

Although the Technological Pedagogical Content Knowledge (TPACK) framework—defined as the integrated knowledge that enables teachers to combine content, pedagogy, and technology effectively (Mishra & Koehler, 2006)—has long guided teachers in integrating conventional digital tools (Schmidt et al., 2009; Mishra et al., 2023), generative AI such as ChatGPT fundamentally challenges this model by autonomously producing ideas, language, and content (Alnasib, 2023; Atchley et al., 2024). This independent output blurs the traditional boundaries between technological, pedagogical, and content knowledge, requiring educators to develop new skills in the areas of critical evaluation, ethical oversight, and adaptive pedagogy (Banihashem et al., 2024; Rasul et al., 2023).

Existing TPACK models may be insufficient to address the complexities introduced by generative AI, highlighting the need to reconceptualize its dimensions to ensure responsible and meaningful use (Mishra et al., 2023). Understanding the ways in which instructors' TPACK levels relate to ChatGPT adoption can provide theoretical and practical insights for evolving teacher knowledge frameworks suited to AI-driven contexts (Yue et al., 2024). To address these questions, this study employed a cross-sectional survey design with a purposive sample of university faculty members in Peru, using validated Likert-scale instruments and non-parametric analyses to examine the relationships between TPACK levels, demographic factors, and the adoption of ChatGPT for teaching.

Moreover, cultural factors—such as a strong preference for lecture-based instruction, limited institutional support, and varying levels of AI literacy in Latin American universities—may mediate the way in which TPACK principles are applied when using generative AI tools (Castagnola Rossini et al., 2024; UNESCO, 2022). Therefore, analyzing this cultural dynamic is key to designing training programs and policies that are appropriately adapted to regional needs (Medina et al., 2024).

Building on this theoretical and contextual background, this study examines how university instructors' TPACK levels relate to their educational use of ChatGPT, considering factors such as gender, age, and teaching experience. In doing so, it addresses a gap in the literature by linking an established pedagogical framework with the challenges posed by autonomous generative AI, especially in the Latin American higher education context.

Despite the growing interest in integrating ChatGPT into higher education, most existing studies to date have focused on students' perspectives or general AI awareness, providing limited empirical evidence to elucidate the ways in which university faculty members apply established frameworks such as the Technological Pedagogical Content Knowledge (TPACK) when using generative AI. This study addresses this gap by examining how instructors' TPACK levels relate to their educational use of ChatGPT in Peru, a context characterized by persistent digital divides and limited AI-specific training. By offering new empirical insights from Latin America, the research not only highlights the practical challenges but also emphasizes opportunities for updating teacher knowledge frameworks to meet the demands of autonomous AI tools.

Specifically, the study aims to determine the TPACK levels demonstrated by university faculty members, identify demographic differences in ChatGPT use, and assess the extent to which TPACK predicts pedagogically meaningful AI integration. Additionally, the findings will inform a critical discussion on the theoretical implications and possible extensions of the TPACK framework in the context of generative AI.

2. Literature Review

2.1. Educational Use of ChatGPT

Generative artificial intelligence (GenAI) refers to AI systems that can autonomously create new content—such as text, images, or code—by learning from existing data patterns. In particular, the emergence of ChatGPT as a generative artificial intelligence (GenAI) tool has sparked a growing interest in its application within higher education (Celik, 2023). Developed by OpenAI, ChatGPT uses advanced natural language processing to generate human-like responses, enabling students and educators to interact with complex academic content in real time (De Jesus et al., 2024). Already, in university settings, ChatGPT is frequently used to assist with brainstorming, drafting written assignments, summarizing texts, and retrieving academic information (Duong, 2024; Essien et al., 2024). Its versatility has led scholars to view it as a potential ally for enhancing student autonomy, productivity, and engagement in the learning process (Funda & Mbangeleli, 2024; Fuchs, 2023).

Despite its benefits, the integration of ChatGPT into teaching and learning has raised pedagogical and ethical concerns. For example, several researchers have warned that unregulated use of ChatGPT may undermine critical thinking and reduce students' efforts to internalize academic content (Goh & Sandars, 2024; Gouia-Zarrad & Gunn, 2024). Academic institutions have responded variably, with some encouraging its responsible use under supervision and others limiting or banning its application in coursework to preserve academic integrity (Grájeda et al., 2024; Guo & Lee, 2023). Indeed, the ongoing debate highlights the dual role of ChatGPT—as both a learning enhancer and a source of potential academic shortcuts.

Educational outcomes associated with ChatGPT use appear to depend largely on the way in which the tool is framed and guided by instructors. When integrated as part of a structured, pedagogical strategy, ChatGPT can support metacognitive development, argument construction, and advanced writing processes (Han et al., 2024; Hidayat et al., 2024). However, passive or unguided reliance on the tool may lead to superficial learning and diminished student accountability (Iqbal & Rahman., 2024; Liu et al., 2024). Arguably, this underscores the importance of digital literacy and AI fluency among both students and faculty members to ensure the ethical and effective integration of ChatGPT into academic environments (Losi et al., 2024; Luciano, 2024; Ríos Gonzales et al., 2025).

The unique feature that sets ChatGPT apart from traditional educational technologies is its autonomous generation of novel ideas, arguments, and text, which can be employed either to support or to substitute students' cognitive processes. Furthermore, this raises questions as to how educators can guide and

evaluate AI-generated content to maintain academic rigor and integrity. Without structured pedagogical frameworks, relying on ChatGPT may blur the line between student authorship and machine assistance. Collectively, these challenges underscore the importance of examining ChatGPT through established teacher knowledge frameworks—specifically TPACK—to assess whether its traditional dimensions suffice or whether theoretical expansion is required to manage AI's dynamic and autonomous capabilities responsibly.

2.2. TPACK Framework and AI Context

The Technological Pedagogical Content Knowledge (TPACK) framework builds on Shulman's (1986) original concept of Pedagogical Content Knowledge (PCK), which emphasized that effective teaching requires not only knowledge of the subject matter (CK) and pedagogy (PK) but the integrated understanding of both. Expanding on this, Mishra and Koehler added Technological Knowledge (TK), proposing that effective technology integration demands a dynamic interplay between content, pedagogy, and technology domains (Schmidt et al., 2009; Mishra et al., 2023).

The model encompasses seven interconnected components: Content Knowledge (CK); Pedagogical Knowledge (PK); Technological Knowledge (TK); and the overlapping constructs of Pedagogical Content Knowledge (PCK); Technological Content Knowledge (TCK); Technological Pedagogical Knowledge (TPK); and the integrative TPACK; representing the synergy of all three domains for meaningful technology-enhanced teaching (Yue et al., 2024; Murtiningsih et al., 2024).

In practice, these domains do not function in isolation. While CK informs what to teach, PK addresses how to teach, and TK provides the tools needed for teaching. PCK links content and pedagogy, guiding teachers to select the most appropriate methods for specific topics. TPK emphasizes how technology reshapes pedagogical strategies, while TCK relates to the ways in which technology can represent and transform subject matter. Nevertheless, when teachers have strong CK and PK but limited TK, difficulties arise and may result in superficial technology use or misalignment with learning objectives (Muniruzzaman & Afrin, 2024; Mugableh, 2024).

In higher education, this interplay is further shaped by institutional culture, training availability, and individual beliefs (Saleem et al., 2024; Saharuddin et al., 2024). Research indicates that university instructors with robust TPACK design more student-centered, technology-rich learning environments (Mun, 2024; Yue et al., 2024). However, studies show disparities in educators' confidence levels when managing newer tools such as generative AI, which autonomously generates content and challenges conventional TPACK boundaries (Mishra et al., 2023; Wang et al., 2024).

Consequently, this recognition has led scholars to propose AI-TPACK extensions that integrate AI-specific literacy, ethical oversight, and critical evaluation skills into the original framework (Wang et al., 2024). Such proposals reflect the need for TPACK to remain flexible and context-sensitive, as educators navigate rapidly advancing generative AI applications such as ChatGPT in university settings.

In summary, while the TPACK framework has guided digital tool integration for over a decade, its conventional dimensions may not fully address the complexities posed by autonomous generative AI such as ChatGPT. Therefore, faculty members not only need technological and pedagogical proficiency but also new competencies in critically evaluating machine-generated content, ensuring ethical use, and adapting pedagogy dynamically. Thus, there is an urgent need to revisit TPACK's scope and test how well faculty members' current knowledge predicts practical AI adoption in higher education, particularly in under-researched Latin American contexts.

2.3. Empirical Studies on TPACK and ChatGPT

Recent empirical studies have explored the intersection between the TPACK framework and the educational use of ChatGPT in higher education, although much of this research remains fragmented and context dependent. Introducing the concept of AI-TPACK, Mishra et al. (2023) argued that the traditional dimensions of TPACK should be expanded to include teachers' knowledge of artificial intelligence tools, particularly generative AI such as ChatGPT. In summary, their study emphasizes that the successful integration of ChatGPT into educational environments depends not only on technological proficiency but also on pedagogical and ethical preparedness.

Other researchers have begun to assess how university faculty members perceive and utilize ChatGPT in their teaching. A recent study involving higher education instructors, conducted by Yue et al. (2024), found that those with higher levels of TPACK demonstrated greater confidence and pedagogical flexibility when adopting ChatGPT for instructional design and formative feedback. Similarly, Kim et al. (2022) reported that instructors who had received targeted training on AI applications showed greater effectiveness in using ChatGPT to support collaborative learning and problem-solving.

Despite these promising findings, important gaps remain in literature. Most studies to date have focused on students' use of ChatGPT rather than faculty integration, and few offer structured interventions or in-depth analysis of the pedagogical strategies associated with TPACK. For instance, Lindner and Berges (2020) found that many educators held vague or uncertain preconceptions regarding artificial intelligence, which affected their willingness to adopt tools such as ChatGPT. Furthermore, Zhang and Li (2024) emphasized that in the absence of clear guidelines and institutional support, teachers tend to avoid AI technologies or apply them inconsistently, often failing to align them with curriculum objectives.

Geographic disparities are also evident in the research. While interest is growing in regions such as East Asia and Europe, studies in Latin America—particularly in Peru—remain scarce. Ríos Gonzales et al. (2025) identified significant differences in digital competence and TPACK according to gender, academic discipline, and institutional context, highlighting the need for localized investigations. Thus, these findings reveal an urgent need to examine the ways in which university faculty members in underrepresented contexts perceive and utilize ChatGPT through the lens of the TPACK framework.

This review suggests that although progress has been made in conceptualizing AI-TPACK and its implications for teaching, more empirical evidence and theory-driven propositions are urgently needed in order to understand how ChatGPT is being integrated into university teaching practices, especially in developing countries. Therefore, the present study addresses this gap by investigating the relationship between TPACK levels and the educational use of ChatGPT among Peruvian university instructors, generating data that can inform both future training programs and institutional policies.

To date, the limited empirical evidence provides useful correlations but lacks robust theoretical propositions explaining why certain TPACK dimensions may better predict ChatGPT adoption. For instance, one might expect Technological Pedagogical Knowledge (TPK) and Technological Content Knowledge (TCK) to be especially critical when dealing with AI-generated content that requires verification and contextual adaptation. Similarly, demographic factors—such as prior AI training and cultural teaching normally moderate these relationships, reinforcing the need for context-sensitive frameworks. Addressing these theoretical gaps therefore moves this study beyond descriptive correlation and toward a hypothesis-driven examination of the ways in which teacher knowledge frameworks interact with emerging AI capabilities.

2.4. Proposed Theoretical Model

Grounded in the reviewed literature, the theoretical model proposed in this study posits that university instructors' Technological Pedagogical Content Knowledge (TPACK) functions as an antecedent variable shaping the frequency, purpose, and perceived effectiveness of ChatGPT use for educational purposes. Building on recent critiques of TPACK's sufficiency for autonomous generative AI, the model specifies that dimensions such as Technological Pedagogical Knowledge (TPK) and Technological Content Knowledge (TCK) are likely to play a more predictive role, in view of ChatGPT's capacity to generate novel, unsupervised content that demands critical pedagogical framing and content validation.

This proposition extends the traditional understanding of TPACK by highlighting the need for AI-specific literacy and ethical oversight to be integrated into faculty members' knowledge frameworks. Furthermore, the model includes personal and contextual moderators—including prior AI training, cultural teaching norms, and institutional policy support—that may amplify or constrain the translation of TPACK into practical, responsible ChatGPT adoption. By articulating these theoretical mechanisms, the model provides a foundation for hypothesis-driven analysis and contributes to ongoing discussions regarding the ways in which teacher knowledge frameworks must evolve in order to address generative AI's dynamic educational impact.

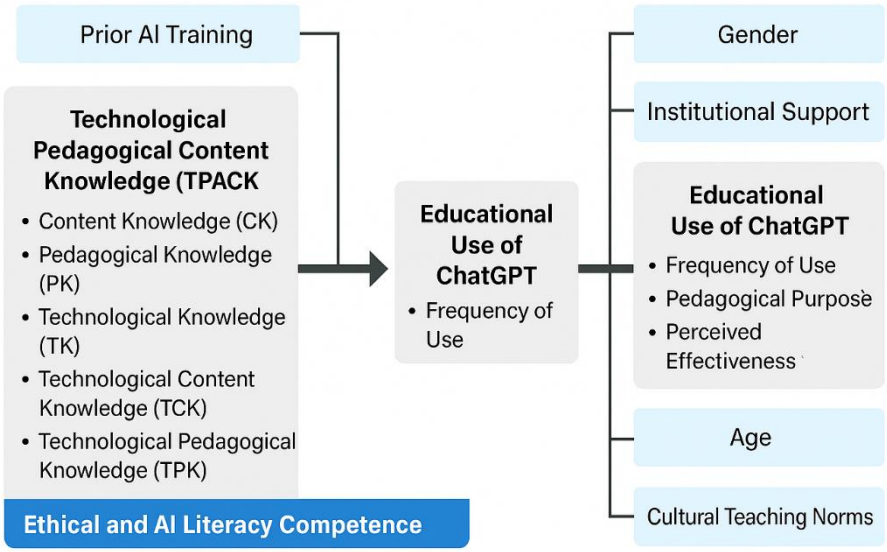

Figure 1. Theoretical model linking TPACK dimensions, contextual moderators, and educational use of ChatGPT.

3. Methodology

3.1. Research Design

This study employed a non-experimental, cross-sectional, correlational, and explanatory design with a quantitative approach. The objective was to examine the relationship between university instructors' Technological Pedagogical Content Knowledge (TPACK) and their educational use of ChatGPT. This design is appropriate for analyzing statistical associations between naturally occurring variables in real educational contexts without manipulation (Cohen et al., 2018; Hernández et al., 2021). However, it does not allow for causal inference or the examination of dynamic changes in AI adoption over time, which should be addressed in future longitudinal research (Anand, 2024).

3.2. Population and Sample

The study population consisted of university instructors from six public and private universities located in the city of Trujillo, Peru. A non-probabilistic convenience sampling method was used, ensuring accessibility, willingness, and voluntary participation to complete both instruments. The inclusion criterion was that each participant must be an active faculty member during the 2025-I academic semester in any of the selected institutions.

It must be noted that this convenience sampling approach introduces inherent selection bias, as participation depended on voluntary self-selection and digital access, which may not represent all faculty demographics equally. Although practical constraints made probability sampling unfeasible, this methodological choice limits the generalizability of the results, both within Peru and across Latin America. Future studies should therefore implement stratified or multi-stage sampling to enhance representativeness and control for institutional differences and self-selection effects. Consequently, the findings should be interpreted with caution, acknowledging that they may not be statistically generalized to the entire university faculty population.

The final sample included 180 instructors, both male and female, aged between 27 and 66 years, with varying levels of teaching experience (ranging from under five years to over 20 years), and representing a range of academic fields including social sciences, education, engineering, and health. This sample size was considered adequate for correlational studies and supported robust statistical analysis, following Cohen's (2018) recommendations. All participants provided informed consent and completed the full questionnaire.

3.3. Data Collection Techniques and Instruments

The data collection technique was a structured survey, administered virtually through an online form. This approach enabled efficient and standardized data gathering across multiple institutions.

The first instrument was a TPACK self-assessment questionnaire adapted from the validated model by Schmidt et al. (2009). After the wording was adjusted to ensure cultural and linguistic relevance in the Peruvian context, five experts in educational technology and pedagogy reviewed the instrument to ensure content validity. The questionnaire included 35 items distributed across seven dimensions: Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Knowledge (TK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and the integrated TPACK construct. All items used a five-point Likert scale (1 = strongly disagree, 5 = strongly agree).

The second instrument was a questionnaire on the educational use of ChatGPT, developed by synthesizing dimensions reported in recent AI-TPACK studies and reviewed by the same expert panel. It contained 20 items, which were organized into three dimensions, frequency of use, pedagogical purpose, and perceived effectiveness—using the same five-point Likert scale.

Both instruments underwent a pilot test with 30 instructors to refine item clarity, confirm contextual relevance, and verify reliability. Separate Cronbach's alpha coefficients were calculated, yielding 0.87 for the TPACK questionnaire and 0.85 for the ChatGPT questionnaire, indicating high internal consistency according to Taber (2018). For interpretation, the total scores were categorized into five levels (Very Low, Low, Medium, High, Very High), based on the total possible scores, pilot data distribution, and expert judgment to ensure meaningful distinctions for practice.

3.4. Procedure

Three stages were involved in the data collection procedure. First, a self-administered digital form was created, including both validated instruments and an informed consent statement explaining the participants' anonymity, confidentiality, and voluntary participation.

Second, the form was distributed directly to faculty members through academic networks, email lists, and virtual communication channels, with a two-week response window.

Third, collected data were reviewed for completeness, consistency, and logical coherence. Cases with more than 10% missing responses were excluded. Where

necessary and feasible, clarifications were obtained through follow-up contact. The entire process was conducted between March and April 2025, adhering to ethical principles for educational research.

3.5. Ethical Considerations

The study was conducted according to the ethical principles outlined in the Declaration of Helsinki and followed the Educational Research Ethics Committee's guidelines. Participation was entirely voluntary, based on acceptance and completion of an informed consent form, explaining the study's purpose, data usage, and confidentiality.

No sensitive or personal data were collected, and no intervention was performed; therefore, formal institutional ethics committee approval was neither required nor requested. All data was used exclusively for academic purposes, preserving participants' professional integrity and privacy.

3.6. Study Variables

This study focused on two main variables: the instructors' level of Technological Pedagogical Content Knowledge (TPACK) and their reported educational use of ChatGPT. Both variables were measured using structured Likert-scale questionnaires and were treated as ordinal variables for analysis purposes.

Based on the framework proposed by Schmidt et al. (2009), which remains a widely used standard for TPACK research (Yue et al., 2024), the TPACK variable included seven dimensions, as follows: Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Knowledge (TK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and the integrated TPACK construct. Each dimension reflected instructors' self-perceived professional competencies.

The educational use of ChatGPT variable was organized into three dimensions: (1) frequency of use in academic contexts, (2) pedagogical purpose (such as class preparation, feedback, or assessment), and (3) perceived effectiveness in supporting learning. These dimensions were adapted from the works of Mishra et al. (2023) and Yue et al. (2024).

3.7. Data Analysis Techniques

Data analysis was performed at descriptive, comparative, and inferential levels. Descriptive statistics (frequencies, means, standard deviations) were used to summarize the main variables. Spearman's rank-order correlation tested the associations between TPACK and ChatGPT use. Furthermore, the Mann–Whitney U and Kruskal–Wallis tests were employed to examine differences according to gender, age, and academic discipline.

An ordinal logistic regression was applied to assess the predictive effect of TPACK levels on ChatGPT use. Although appropriate for ordinal outcomes, interaction effects and potential hierarchical clustering by institution were not modeled due to sample constraints; as a result, inferences should be interpreted cautiously. Future research should consider multilevel modeling to address institutional variance. Analyses were performed using Microsoft Excel and SPSS v26. The overall reliability (Cronbach's alpha) was 0.89.

3.8. Methodological Limitations

The findings should be interpreted with caution due to several methodological limitations. First, the convenience sampling method used introduces selection bias. Furthermore, the cross-sectional design prevents causal conclusions, and self-reported measures may reflect social desirability bias. Additionally, although instruments were adapted and validated by experts, full psychometric testing (e.g. factor analysis) was not conducted in the Peruvian context. Future studies should therefore address these issues by employing probability sampling, longitudinal designs, and comprehensive validation procedures to strengthen the generalizability and theoretical rigor.

4. Results

The results are presented in accordance with the research objectives and the theoretical model, following a data-driven approach that prioritizes the transparent presentation of raw findings before providing detailed interpretation. Descriptive and inferential statistics are reported for the two main variables: Technological Pedagogical Content Knowledge (TPACK) and the educational use of ChatGPT. In order to facilitate clarity and replicability, each table presents categorized performance levels or test results, followed by an analytical summary that explains the main patterns, practical significance, and implications for faculty development and policy.

Table 1. Score ranges and level interpretation for the TPACK variable and its dimensions

Variable	Scale	Level
TPACK Total	[35–62]	Very Low
	[63-90]	Low
	[91-118]	Medium
	[119-146]	High
	[147-155]	Very High
Dimensions	Scale	Level
Content Knowledge	[5–9]	Very Low
	[10-14]	Low
	[15-17]	Medium
	[18-21]	High
	[22-25]	Very High
Pedagogical Knowledge	[5–9]	Very Low
	[10-14]	Low
	[15-17]	Medium
	[18-21]	High
	[22-25]	Very High
Technological Knowledge	[5–9]	Very Low
	[10-14]	Low
	[15-17]	Medium
	[18-21]	High
	[22-25]	Very High
Pedagogical Content Knowledge	[5–9]	Very Low
	[10-14]	Low

	[15-17]	Medium
	[18-21]	High
	[22-25]	Very High
Technological Pedagogical Knowledge	[5–9]	Very Low
	[10-14]	Low
	[15-17]	Medium
	[18-21]	High
	[22-25]	Very High
Technological Content Knowledge	[5–9]	Very Low
	[10-14]	Low
	[15-17]	Medium
	[18-21]	High
	[22-25]	Very High
Integrated TPACK	[5–9]	Very Low
	[10-14]	Low
	[15-17]	Medium
	[18-21]	High
	[22-25]	Very High

Note. This scale defines the categorical levels used to interpret faculty TPACK scores, based on a five-point Likert scale and the total number of items.

Table 2. Score ranges and level interpretation for the ChatGPT variable and its dimensions

Variable	Scale	Level
ChatGPT Total	[20–35]	Very Low
	[36-51]	Low
	[52-67]	Medium
	[68-83]	High
	[84-100]	Very High
Dimensions	Scale	Level
Frequency of Use	[6–10]	Very Low
	[11-15]	Low
	[16-20]	Medium
	[21-25]	High
	[26-30]	Very High
Pedagogical Purpose	[7–12]	Very Low
	[13-18]	Low
	[19-24]	Medium
	[25-30]	High
	[31-35]	Very High
Perceived Effectiveness	[7–12]	Very Low
	[13-18]	Low
	[19-24]	Medium
	[25-30]	High
	[31-35]	Very High

Note: This scale categorizes the frequency, purpose, and perceived effectiveness of ChatGPT use, facilitating consistent result interpretation.

4.1. Descriptive Results

Table 3. Distribution of university faculty members by TPACK levels across dimensions

Levels	Very High		High		Medium		Low		Very Low		Total	Total
	f	%	f	%	f	%	f	%	f	%	f	%
TPACK	24	13.13	55	30.6	61	33.9	28	15.6	12	6.7	180	100
Content Knowledge	22	12.2	48	26.7	47	26.1	46	25.6	17	9.4	180	100
Integrated TPACK	28	15.6	56	31.1	51	28.3	32	17.8	13	7.2	180	100
Pedagogical Content Knowledge	24	13.3	41	22.8	59	32.8	40	22.2	16	8.9	180	100
Pedagogical Knowledge	21	11.7	42	23.3	64	35.6	41	22.8	12	6.7	180	100
Technological Content Knowledge	29	16.1	51	28.3	52	28.9	22	12.2	26	14.4	180	100
Technological Knowledge	23	12.8	50	27.8	55	30.6	38	21.1	14	7.8	180	100
Technological Pedagogical Knowledge	33	18.3	38	21.1	58	32.2	32	17.8	19	10.6	180	100

Note. f = frequency; % = percentage of participants within each TPACK level (Very Low, Low, Medium, High, Very High) for each dimension. N = 180.

The distribution indicates that while most instructors score at medium to high levels in such core dimensions as Content Knowledge and Pedagogical Content Knowledge, fewer achieve high scores in Technological Knowledge or Technological Pedagogical Knowledge. This gap highlights ongoing challenges in fully integrating technology into pedagogical practice. Figure 2 visually reinforces these disparities, emphasizing priority areas for faculty development, which should be focused on combining technology with effective teaching strategies, especially when adopting generative AI tools including ChatGPT.

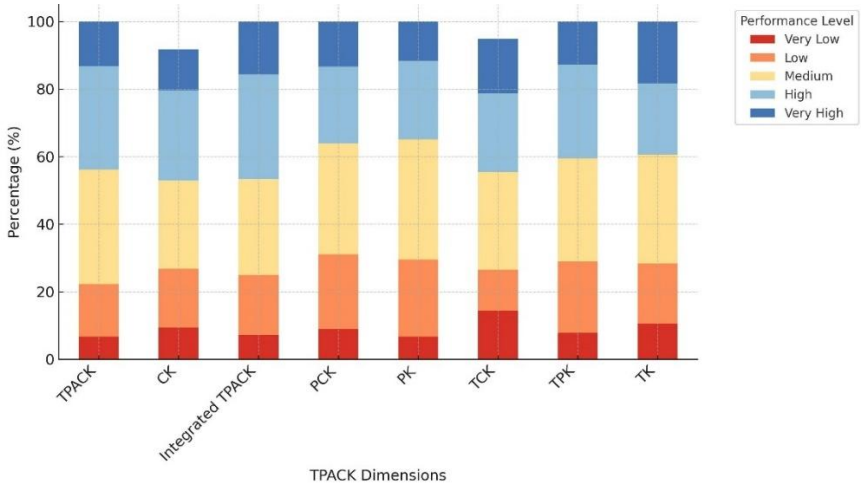

Figure 2. Proportion of university faculty members by TPACK performance levels across dimensions

Table 4. Distribution of university faculty members by ChatGPT levels across dimensions

Levels	Very High		High		Medium		Low		Very Low		Total	Total
	f	%	f	%	f	%	f	%	f	%	f	%
ChatGPT	24	13.13	47	26.1	58	32.2	35	19.4	16	8.9	180	100
Frequency of Use	18	10.0	48	26.7	50	27.8	43	23.9	21	11.7	180	100%
Pedagogical Purpose	21	11.7	41	22.8	60	33.3	42	23.3	16	8.9	180	100%
Perceived Effectiveness	37	20.6	45	25.0	48	26.7	32	17.8	18	10.0	180	100%

Note. Scores are based on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The overall level uses 20 items; each dimension includes grouped items. Levels are categorized as Very Low to Very High for consistent interpretation.

As can be seen in Table 4, the results show that while most faculty members reported medium (32.2%) or high (26.1%) levels of overall ChatGPT use, a considerable proportion nevertheless falls into the low (19.4%) or very low (8.9%) categories. In terms of dimension, Perceived Effectiveness stands out with the highest percentage at the Very High level (20.6%), indicating broad recognition of ChatGPT's potential benefits. However, actual Frequency of Use remains lower, with only 10% reporting Very High use and over a third in the low ranges. Figure 3 visually highlights this mismatch between perceived value and consistent classroom application, pointing to the need for practical training and supportive institutional policies to close this gap.

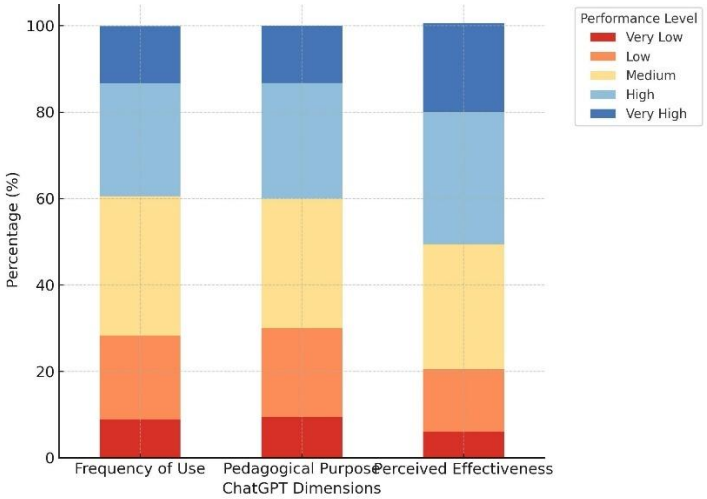

Figure 3. Proportion of university faculty members by ChatGPT use levels across dimensions

Overall, the descriptive results show that most faculty members demonstrate medium to high levels in the core TPACK dimensions, with content and pedagogical knowledge being stronger than technological knowledge. This finding directly addresses Objective 1 by providing a snapshot of faculty members' competencies for integrating ChatGPT. Similar patterns have been reported in regional studies, reinforcing the need to strengthen technological knowledge as an integrated element in professional development initiatives.

4.2 Demographic Differences in Chatgpt Use

4.2.1 Gender

Table 5. Results of the Mann–Whitney U Test on ChatGPT Use by Gender

Test	U Statistic	p-value	Effect Size (r)	Interpretation
Mann–Whitney U	2770.0	0.0003	0.31	Statistically significant difference; moderate effect favoring females

Note. The Mann–Whitney U test compared ChatGPT use scores between 90 male and 90 female university faculty members. The result shows a statistically significant difference ($p < .05$), with female faculty members reporting higher usage levels. The effect size (r) was calculated as $Z/\sqrt{N}$, indicating a moderate practical impact.

A Mann–Whitney U test revealed a statistically significant difference in ChatGPT use by gender ($U = 2770.0$, $p = .0003$), with female faculty members reporting higher usage levels compared to their male counterparts. The effect size ($r = 0.31$) indicates a moderate practical difference.

4.2.2 Age

Table 6. Results of the Kruskal–Wallis Test on ChatGPT Use by Age Group

Test	H Statistic	p-value	Interpretation
Kruskal–Wallis	9.08	0.0107	Statistically significant difference

Note. The result indicates that differences in ChatGPT usage exist across age groups. The difference was statistically significant at $p < .05$.

A Kruskal–Wallis's test revealed a statistically significant difference in ChatGPT use across age groups ($H = 9.08$, $p = .0107$), with faculty members under 35 years old reporting higher usage levels than their older colleagues.

4.2.3 AI training, teaching experience, academic discipline

Table 7. Statistical Tests of Professional Differences in the Educational Use of ChatGPT

Test	**Variable**	**Statistic**	***p*-value**	**Interpretation**
Mann–Whitney U	Prior AI training	6650.00	0.0000	Significant
Kruskal–Wallis	Teaching experience	0.06	0.9727	Not significant
Kruskal–Wallis	Academic discipline	1.39	0.7089	Not significant

Note. The Mann–Whitney U test compared faculty members with and without prior AI training, showing a statistically significant difference in ChatGPT use ($p < .05$). The Kruskal–Wallis tests assessed differences according to years of teaching experience and academic discipline; no significant differences were found for these factors. A significance threshold of $p < .05$ was used for all tests.

ChatGPT use showed a statistically significant difference based on prior AI training ($U = 6650.00$, $p < .001$), with faculty members who had previously received AI training reporting higher usage levels than those without training. In contrast, no significant differences were found according to teaching experience ($p = .9727$) or academic discipline ($p = .7089$).

In summary, the analyses revealed statistically significant differences in ChatGPT use by gender, age, and prior AI training, with female, younger, and trained faculty members reporting higher usage levels. However, no significant differences were found for teaching experience or academic discipline. These patterns directly address Objective 2 and align with trends noted in related studies on digital tool adoption, which also highlight demographic and training-related disparities. The following section examines the predictive relationship between TPACK levels and ChatGPT use.

4.3 Predictive Influence of TPACK on ChatGPT Use

Table 8. Correlation between TPACK and Educational Use of ChatGPT

Test	Correlation Coefficient (ρ)	p-value	Effect Size Interpretation
Spearman's Rho	0.547	< .001	Moderate

Note. Spearman's Rho was calculated as a sample of 180 university faculty members. The correlation is statistically significant at $p < .05$.

A Spearman's Rho test revealed a moderate, statistically significant correlation ($\rho = 0.547$, $p < .001$) between faculty members' TPACK levels and their ChatGPT use, indicating that instructors with better integrated pedagogical, technological, and content knowledge are more likely to adopt ChatGPT. However, the ordinal logistic regression showed the minimal predictive power of TPACK dimensions alone (Nagelkerke $R^2 = 0.036$), suggesting that additional factors influence AI adoption.

Table 9. Ordinal Logistic Regression Predicting ChatGPT Use Based on TPACK

Parameter	Coefficient	p-value	95% CI Lower	95% CI Upper
T PACK	.0004	0.9699	-0.0181	-0.0188
1/2	-2.1558	0.055	-4.3575	0.0458
2/3	0.2801	0.0858	0.0394	0.5996
3/4	0.2644	0.0262	0.0313	0.4975
4/5	0.3336	0.0155	0.0635	0.6037

Note. ChatGPT use was modeled as an ordinal outcome (1 = Very Low, 5 = Very High) predicted by the total TPACK score. The coefficient was not significant ($p = .9699$) and model fit was low (Nagelkerke $R^2 = 0.036$). 95% confidence intervals are shown.

The ordinal logistic regression analysis showed that the total TPACK score did not significantly predict ChatGPT use ($p = 0.9699$, Nagelkerke $R^2 = 0.036$). Some categories showed marginally significant coefficients, but overall model fit remained low.

Table 10. Ordinal Logistic Regression Predicting ChatGPT Use by TPACK Dimensions

Parameter	Coefficient	p-value	95% CI Lower	95% CI Upper
CK	0,0394	0,3865	-0,0498	0,1287
PK	-0,0391	0,4999	-0,1526	0,0744
TK	0,0446	0,2402	-0,0298	0,1191
PCK	0,0736	0,0935	-0,0124	0,1597
TPK	0,0544	0,3388	-0,0571	0,1659
TCK	-0,0126	0,7986	-0,109	0,0839
Integrated_TPACK	-0,0428	0,5031	-0,1683	0,0826
1/2	-0,154	0,955	-5,4975	5,1896
2/3	0,2985	0,0662	-0,02	0,6169

3/4	0,29	0,0151	0,056	0,524
4/5	0,3512	0,0107	0,0814	0,6209

Note. ChatGPT was modeled as an ordinal outcome predicted by the seven TPACK dimensions. No predictor was statistically significant ($p > .05$), although PCK showed a marginal effect ($p = .0935$). Model fit was low (Nagelkerke $R^2 = 0.036$). 95% confidence intervals are reported.

The multivariate ordinal logistic regression analysis showed that none of the seven TPACK dimensions significantly predicted ChatGPT use levels when analyzed simultaneously (all $p > .05$). Pedagogical Content Knowledge (PCK) showed a marginal effect ($p = .0935$), but this failed to reach the conventional significance threshold. Model fit was low (Nagelkerke $R^2 = 0.036$).

Together, these results confirm a moderate correlation between TPACK levels and ChatGPT use but reveal the limited predictive power of both the global TPACK score and individual dimensions. Thus, this finding addresses Objective 3 and supports recent literature suggesting that traditional TPACK components may not fully explain faculty members' adoption of generative AI tools, underlining the need to expand the framework to include AI-specific competencies and contextual factors.

5. Discussion

This study confirmed that university faculty members generally exhibit moderate to high TPACK levels, with stronger content and pedagogical knowledge and weaker technological integration, thereby supporting the patterns reported by Muniruzzaman and Afrin (2024) and Yue et al. (2024). Furthermore, this aligns with regional findings highlighting that faculty members often feel more confident in terms of domain expertise compared to technology use, reinforcing the need for targeted support in attaining technological proficiency.

Demographic analyses showed significant differences in ChatGPT use related to gender, age, and prior AI training, echoing the trends observed by Castagnola Rossini et al. (2025) and Atchley et al. (2024). Females and younger instructors demonstrated higher adoption, suggesting that digital confidence, innovation attitudes, and access to relevant training shape practical AI use. Moreover, this implies that institutional policies should be mindful of demographic diversity when bridging adoption gaps.

The moderate Spearman's correlation indicates that higher TPACK correlates with more frequent ChatGPT use, yet the ordinal regression reveals the low predictive power of TPACK dimensions alone. This reinforces recent findings (Wang et al., 2024) that indicate conventional TPACK may not fully capture the unique requirements of generative AI. As discussed, contextual and psychological factors such as educators' self-efficacy, perceived institutional support, and workload constraints may moderate this relationship.

Overall, these findings highlight the urgency of expanding TPACK to an AI-specific version. An AI-TPACK model is needed to integrate critical content evaluation, ethical oversight, and adaptive pedagogical strategies for generative AI contexts. Institutions should embed scenario-based training, ethical

guidelines, and discipline-sensitive resources in order to foster confident and responsible AI integration.

In summary, this study contributes to advancing both the theoretical and practical understanding of faculty preparedness for generative AI adoption in Latin American higher education—a region still underrepresented in empirical AI studies. By clarifying current competencies and identifying demographic disparities, this research can help inform both policymakers and educational leaders in building inclusive, AI-ready teaching communities.

6. Conclusion

This study demonstrates that university faculty members in a Latin American context possess moderate to high levels of TPACK, with stronger content and pedagogical domains but weaker technological integration. Demographic factors such as gender, age, and prior AI training influence ChatGPT adoption, while TPACK alone shows limited predictive capacity for actual use. Collectively, these insights highlight the importance of updating faculty training and development to include AI-specific literacy and ethical awareness, thereby supporting responsible and effective generative AI integration. Future research should refine the AI-TPACK framework, examine additional contextual moderators, and apply longitudinal or mixed-method designs to deepen understanding of sustainable AI adoption in higher education.

7. Limitations and Future Research

This study has several methodological limitations. First, the use of a geographically confined sample from universities in Trujillo limits the generalizability of the findings to broader educational contexts. Second, reliance on self-reported data may introduce response and social desirability bias. Third, the cross-sectional design restricts any causal interpretation of the relationship between TPACK levels and ChatGPT use. Finally, other contextual and psychological factors that may influence AI adoption were not included in the model, which could explain the low predictive power found in the regression analysis.

8. Implications

It would be interesting for future research to validate these findings in other Latin American and international contexts. Furthermore, longitudinal or experimental designs are recommended to examine causal relationships over time. Combining quantitative surveys with classroom observations and in-depth interviews would also help to enhance data validity through triangulation. Additionally, researchers should explore the ways in which AI-specific TPACK dimensions interact with institutional policies, resource availability, and faculty attitudes to refine teacher knowledge frameworks for effective generative AI integration.

9. References

Adiguzel, T., Kaya, M. H., & Cansu, F. K. (2023). Revolutionizing education with AI: Exploring the transformative potential of ChatGPT. *Contemporary Educational Technology*, 15(3), Article 429. https://doi.org/10.30935/cedtech/13152

Aldawsari, H. K., Shahat, H. A., Al-Ruwaili, H. A., Gaber, S. A., Aldughaysh, A. M., & Mohmed, T. A. (2023). Developing productive thinking skills in the field of artistic works using the SCAMPER strategy for twice exceptional students. *International Journal of Learning, Teaching and Educational Research, 22*(12), 1–20. https://doi.org/10.26803/ijlter.22.12.1

Alnasib, B. N. M. (2023). Factors affecting faculty members' readiness to integrate artificial intelligence into their teaching practices: A study from the Saudi higher education context. *International Journal of Learning, Teaching and Educational Research*, 22(8), 465–491. https://doi.org/10.26803/ijlter.22.8.24

Almulla, M., & Ali, S. I. (2024). The changing educational landscape for sustainable online experiences: Implications of ChatGPT in Arab students' learning experience. *International Journal of Learning, Teaching and Educational Research*, 23(9), 285–306. https://doi.org/10.26803/ijlter.23.9.15

Alrishan, A. M. (2023). Determinants of intention to use ChatGPT for professional development among Omani EFL pre-service teachers. *International Journal of Learning, Teaching and Educational Research*, 22(12), 187–209. https://doi.org/10.26803/ijlter.22.12.10

Anand, M. D. (2024). *Research methodology: methods and techniques*. SAN Publications. https://doi.org/10.59646/rmmt/171

Atchley, P., Pannell, H., Wofford, K., Hopkins, M., & Atchley, R. A. (2024). Human and AI collaboration in the higher education environment: Opportunities and concerns. *Cognitive Research: Principles and Implications*, 9(20). https://doi.org/10.1186/s41235-024-00547-9

Banihashem, S. K., Taghizadeh Kerman, N., Noroozi, O., Moon, J., & Drachsler, H. (2024). Feedback sources in essay writing: Peer-generated or AI-generated feedback? *International Journal of Educational Technology in Higher Education*, 21(23). https://doi.org/10.1186/s41239-024-00455-4

Bitzenbauer, P. (2023). ChatGPT in physics education: A pilot studies easy-to-implement activity. *Contemporary Educational Technology*, 15(3), ep430. https://doi.org/10.30935/cedtech/13176

Bukar, U. A., Sayeed, M. S., Abdul Razak, S. F., Yogarayan, S., & Sneesl, R. (2024). Prioritizing ethical conundrums in the utilization of ChatGPT in education through an analytical hierarchical approach. *Education Sciences*, 14(9), 959. https://doi.org/10.3390/educsci14090959

Castagnola Rossini, G., Urbano Gutiérrez, L. P., & Pérez Azahuanche, M. A. (2025). La inteligencia artificial para desarrollar las habilidades investigativas en docentes universitarios [Artificial intelligence to develop research skills in university professors]. *Horizontes. Revista de Investigación en Ciencias de la Educación*, 9(37), 1009–1026. https://doi.org/10.33996/revistahorizontes.v9i37.965

Celik, I. (2023). Towards Intelligent-TPACK: An empirical study on teachers' professional knowledge to ethically integrate artificial intelligence (AI)-based tools into education. *Computers in Human Behavior*, 138, 107468. https://doi.org/10.1016/j.chb.2022.107468

Chamorro-Atalaya, O., Huarcaya-Godoy, M., Durán-Herrera, V., Nieves-Barreto, C., Suarez-Bazalar, R., Cruz-Telada, Y., Alarcón-Anco, R., Huayhua-Mamani, H., Vargas-Diaz, A., & Balarezo-Mares, D. (2023). Application of the chatbot in university education: A systematic review on the acceptance and impact on learning. *International Journal of Learning, Teaching and Educational Research*, 22(9), 156–178. https://doi.org/10.26803/ijlter.22.9.9

Chamorro-Atalaya, O., Morales-Romero, G., Trinidad-Loli, N., Caycho-Salas, B., Guía-Altamirano, T., Auqui-Ramos, E., Rocca-Carvajal, Y., Arones, M., Arévalo-Tuesta, J. A., & Gonzales-Huaytahuilca, R. (2023). Gamification in engineering education during COVID-19: A systematic review on design considerations and success factors in its implementation. *International Journal of Learning, Teaching and Educational Research*, 22(6), 301–327. https://doi.org/10.26803/ijlter.22.6.17

Cohen, L., Manion, L. y Morrison, K. (2018). Research Methods in Education (8a ed.). *Routledge*. https://doi.org/10.4324/9781315456539

Dergaa, I., Chamari, K., Zmijewski, P., & Saad, H. B. (2023). From human writing to artificial intelligence generated text: Examining the prospects and potential threats of ChatGPT in academic writing. *Biology of Sport*, 40(2), 615–622. https://doi.org/10.5114/biolsport.2023.125623

De Jesus, F. S., Ibarra, L. M., Pasion, B. J., Villanueva, W., & Leyesa, M. (2024). ChatGPT as an artificial intelligence learning tool for Business Administration students in Nueva Ecija, Philippines. *International Journal of Learning, Teaching and Educational Research*, 23(6), 348–372. https://doi.org/10.26803/ijlter.23.6.16

Duong, C. D. (2024). ChatGPT adoption and digital entrepreneurial intentions: Empirical research based on the theory of planned behaviour. *Entrepreneurial Business and Economics Review*, 12(2), 129–142. https://doi.org/10.15678/EBER.2024.120208

Essien, A., Bukoye, O. T., O'Dea, X., & Kremantzis, M. (2024). The influence of AI text generators on critical thinking skills in UK business schools. *Studies in Higher Education*, 49(5), 865–882. https://doi.org/10.1080/03075079.2024.2316881

Funda, V., & Mbangeleli, N. B. A. (2024). Artificial Intelligence (AI) as a tool to address academic challenges in South African higher education. *International Journal of Learning, Teaching and Educational Research*, 23(11), 1–15. http://dx.doi.org/10.26803/ijlter.23.11.27

Fuchs, K. (2023). Exploring the opportunities and challenges of NLP models in higher education: Is ChatGPT a blessing or a curse? *Frontiers in Education*, 8, Article 1166682. https://doi.org/10.3389/feduc.2023.1166682

Goh, P. S., & Sandars, J. (2024). Application of ChatGPT-assisted problem-based learning teaching method in clinical medical education. *BMC Medical Education*, 24(1), 1-10. https://doi.org/10.1186/s12909-024-04812-5

Gouia-Zarrad, R., & Gunn, C. (2024). Enhancing students' learning experience in mathematics class through ChatGPT. *International Electronic Journal of Mathematics Education*, 19(3), em0781. https://doi.org/10.29333/iejme/14614

Grájeda, A., Córdova, P., Córdova, J. P., Laguna-Tapia, A., Burgos, J., Rodríguez, L., Arandia, M., & Sanjinés, A. (2024). Embracing artificial intelligence in the arts classroom: Understanding student perceptions and emotional reactions to AI tools. *Cogent Education*, 11(1), 2378271. https://doi.org/10.1080/2331186X.2024.2378271

Guo, Y., & Lee, D. (2023). Leveraging ChatGPT for enhancing critical thinking skills. *Journal of Chemical Education*, 100(11), 4876–4883. https://doi.org/10.1021/acs.jchemed.3c00505

Han, X., Wang, J., & Liu, Q. (2024). A qualitative analysis of Chinese higher education students' intentions and influencing factors in using ChatGPT: A grounded theory approach. *Scientific Reports*, 14(1), 1-12. https://doi.org/10.1038/s41598-024-50748-3

Hidayat, D. N., Pratama, H., & Gunawan, H. (2024). Assessing text comprehension proficiency: Indonesian higher education students vs. ChatGPT. *XLinguae*, 17(1), 94–109. https://doi.org/10.18355/XL.2024.17.01.08

Iqbal, Z., & Rahman, S. (2024). Adoption and impact of ChatGPT in computer science education: A case study on a database administration course. *AI Switzerland*, 6(3), 215–231. https://doi.org/10.3390/aiswitzerland6030015

Liu, X., Chen, J., & Wang, Y. (2024). Artificial intelligence and the transformation of higher education institutions: A systems approach. *Sustainability Switzerland*, 16(5), 3456–3471. https://doi.org/10.3390/su16053456

Losi, R. V., Putra, E. P., Ali, N., & Dewi, A. S. (2024). Using Artificial Intelligence (AI) to improve EFL students' writing skills. *International Journal of English and Applied Linguistics*, 4(1), 62–70. https://doi.org/10.47709/ijeal.v4i1.3694

Luciano, R. G. (2024). The dual impact of ChatGPT on learning and ethics among Bachelor of Science in Information Technology (BSIT) students. *International Journal of Learning, Teaching and Educational Research*, 23(12), 78–95. https://doi.org/10.26803/ijlter.23.12.5

Mahapatra, S. (2024). Impact of ChatGPT on ESL students' academic writing skills: A mixed methods intervention study. *Smart Learning Environments*, 11(1), 9. https://doi.org/10.1186/s40561-024-00295-9

Malik, M. A., Amjad, A. I., & Aslam, S. (2024). Global insights: ChatGPT's influence on academic and research writing, creativity, and plagiarism policies. *Frontiers in Research Metrics and Analytics*, 9, Article 1486832. https://doi.org/10.3389/frma.2024.1486832

Masry-Herzallah, A. (2025). TPACK, technological self-efficacy, gender, and online teaching effectiveness: Insights from the COVID-19 crisis. *Humanities and Social Sciences Communications*, 12(1), Article 227. https://doi.org/10.1057/s41599-025-04546-z

Medina, W. A., Flores Velásquez, C. H., Olivares Zegarra, S. del R., Morales Romero, G. P., Quispe Andía, A., Aybar Bellido, I. E., Palacios Huaraca, C. R., Aldana Trejo, F. H., & Bravo, N. A. (2024). Using ChatGPT in university academic writing: A bibliometric review study on the implications for writing reports, papers, essays, and theses. *International Journal of Learning, Teaching and Educational Research*, 23(12), 360–381. https://doi.org/10.26803/ijlter.23.12.19

Mishra, P., Warr, M., & Islam, R. (2023). TPACK in the age of ChatGPT and generative AI. *Journal of Digital Learning in Teacher Education*, 39(4), 235-251. https://doi.org/10.1080/21532974.2023.2247480

Murtiningsih, S., Sujito, A., & Soe, K. K. (2024). Challenges of using ChatGPT in education: A digital pedagogy analysis. *International Journal of Evaluation and Research in Education*, 13(5), 3466–3473. https://doi.org/10.11591/ijere.v13i5.29467

Mugableh, A. I. (2024). The impact of ChatGPT on the development of vocabulary knowledge of Saudi EFL students. *Arab World English Journal, Special Issue on ChatGPT* (April), 265–281. https://dx.doi.org/10.24093/awej/ChatGPT.18

Mun, C. Y. (2024). EFL learners' English writing feedback and their perception of using ChatGPT. *Journal of English Teaching through Movies and Media*, 25(2), 26–39. https://doi.org/10.16875/stem.2024.25.2.26

Muniruzzaman, S. M., & Afrin, S. (2024). Improving academic writing skill: Difficulties encountered by undergraduates of English studies in Bangladesh. *Englisia: Journal of Language, Education, and Humanities*, 11(2), 215–231. https://doi.org/10.22373/ej.v11i2.19918

Nabavi, R., & Farajollahi, M. (2024). Challenges and opportunities of generative AI for higher education as explained by ChatGPT. *Education Sciences*, 14(2), 287–299. https://doi.org/10.3390/educsci14020287

Naher, J., Maruf, M. H., Bakht, S. T., & Sadaf, S. S. (2023). A survey to understand the experience of ChatGPT usage among engineering university students in Bangladesh. *Technium*, 15, 1–8. https://doi.org/10.47577/technium.v15i.9660

Nazari, M., & Saadi, G. (2024). Developing effective prompts to improve communication with ChatGPT: A formula for higher education stakeholders. *Discover Education*, 3, 45. https://doi.org/10.1007/s44217-024-00122-w

OECD. (2024). *Education at a glance 2020: OECD indicators*. OECD Publishing. https://doi.org/10.1787/69096873-en

Octavio, M. M., Argüello, M. V. G., & Pujolà, J. T. (2024). ChatGPT as an AI L2 teaching support: A case study of an EFL teacher. *Technology in Language Teaching & Learning,* 6(1), 1–25. https://doi.org/10.29140/tltl.v6n1.1142

Rasul, T., Nair, S., Kalendra, D., Robin, M., de Oliveira Santini, F., Ladeira, W. J., Sun, M., Day, I., & Rather, R. A. (2023). The role of ChatGPT in higher education: Benefits, challenges, and future research directions. *Journal of Applied Learning & Teaching*, 6(1). https://doi.org/10.37074/jalt.2023.6.1.29

Ríos Gonzales, J. D., Tomanguilla Reyna, J., Vereau Amaya, E. A., & Vásquez Luján, I. G. (2025). Evaluation of the impact of ChatGPT on the development of research skills in higher education. *International Journal of Learning, Teaching and Educational Research*, 24(4), 370–390. https://doi.org/10.26803/ijlter.24.4.18

Saleem, N., Mufti, T., Sohail, S. S., & Madsen, D. Ø. (2024). ChatGPT as an innovative heutagogical tool in medical education. *Cogent Education*, 11(1), 2332850. https://doi.org/10.1080/2331186X.2024.2332850

Saharuddin, M. H., Nasir, M. K. M., & Mahmud, M. S. (2024). Exploring teachers' technological pedagogical content knowledge in utilising artificial intelligence (AI) for teaching. *International Journal of Learning, Teaching and Educational Research*, 24(1), 108–123. https://doi.org/10.26803/ijlter.24.1.7

Smith, K., & Roberts, L. (2024). Assessing pedagogical strategies integrating ChatGPT in English language teaching: A structural equation modelling-based study. *World Journal of English Language,* 14(1), 44–59. https://doi.org/10.5430/wjel.v14n1p44

Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education*, 48(6), 1273–1296. https://doi.org/10.1007/s11165-016-9602-2

Umbase, R. S. (2023). Implementing Technological Pedagogical and Content Knowledge from the Social Studies Learning Management Perspective. *International Journal of Learning, Teaching and Educational Research*, 22(11), 401–418. https://doi.org/10.26803/ijlter.22.11.21

Wang, B., Hu, S. J., Sun, L., & Freiheit, T. (2024). The impact of using ChatGPT on academic writing among medical undergraduates. *Annals of Medicine*, 56(3), 221–230. https://doi.org/10.1080/07853890.2024.2283921

Yang, J., & Wei, H. (2025). Development of a scale of teachers perceived training quality from the perspective of TPACK. *Humanities and Social Sciences Communications*, 12(1), Article 34. https://doi.org/10.1057/s41599-024-04271-z

Yue, M., Jong, M. S.-Y., & Ng, D. T. K. (2024). Understanding K–12 teachers' technological pedagogical content knowledge readiness and attitudes toward artificial intelligence education. *Education and Information Technologies*. https://doi.org/10.1007/s10639-024-12621-2

Zhang, J., & Li, P. (2024). A SWOT analysis of ChatGPT: Implications for educational practice and research. *Innovations in Education and Teaching International*, 61(2), 162–176. https://doi.org/10.1080/14703297.2024.2298473