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Exploring Technological Pedagogical Content Knowledge (TPACK) in the EFL teaching.

ABSTRACT

This article reports finding of research that investigates how foreign languages teachers work in distance and virtual education settings enact Technological, Pedagogical, and Content Knowledge (TPACK) in their teaching practices. Framed by the TPACK model (Mishra & Koehler, 2006), researchers examined opportunities and constraints teachers face when integrating tools into authentic instructional contexts. A mixed methos design was implemented: a survey was used to quantify perceived TPACK integration, and semi-structured interviews explored teachers' perceptions and experiences in greater depth. Findings demonstrated an overall positive orientation toward educational technology; however, participants reported persistent barriers, particularly limited, context-specific preparation for TPACK-informed pedagogy and uneven access to technological resources and institutional support. These findings suggest that the effective TPACK enactment in online and distance language teaching requires more than teachers' technological competence; it also differs on sustained pedagogical guidance, curricular alignment, and organizational conditions that enable meaningful technology use. Findings of this study report useful information for teachers training and professional development, highlighting the need for specific and contextualized training in ICT for teaching foreign languages specifically in distance and virtual learning university programs.

Key words: Technological Pedagogical Content Knowledge (TPACK); English as a Foreign Language (EFL); Technology integration.

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Explorando el Conocimiento tecnológico pedagógico del contenido (TPACK) en la enseñanza de inglés como lengua extranjera (ILE).

RESUMEN

Este artículo presenta los resultados de una investigación que analiza cómo los profesores de lenguas extranjeras que trabajan en entornos de educación a distancia y virtual aplican los

conocimientos tecnológicos, pedagógicos y de contenido (TPACK) en sus prácticas docentes. Enmarcados en el modelo TPACK (Mishra y Koehler, 2006), los investigadores examinaron las oportunidades y limitaciones a las que se enfrentan los profesores a la hora de integrar herramientas en contextos educativos auténticos. Se aplicó un diseño de métodos mixtos: se utilizó una encuesta para cuantificar la integración percibida del TPACK y se realizaron entrevistas semiestructuradas para explorar en mayor profundidad las percepciones y experiencias de los profesores. Los resultados demostraron una orientación general positiva hacia la tecnología educativa; sin embargo, los participantes informaron de barreras persistentes, en particular la preparación limitada y específica del contexto para la pedagogía basada en el TPACK y el acceso desigual a los recursos tecnológicos y al apoyo institucional. Estos resultados sugieren que la aplicación eficaz de TPACK en la enseñanza de idiomas en línea y a distancia requiere algo más que la competencia tecnológica de los profesores; también depende de una orientación pedagógica sostenida, la alineación curricular y las condiciones organizativas que permitan un uso significativo de la tecnología. Los resultados de este estudio proporcionan información útil para la formación y el desarrollo profesional de los profesores, y ponen de relieve la necesidad de una formación específica y contextualizada en TIC para la enseñanza de lenguas extranjeras, concretamente en programas universitarios de aprendizaje a distancia virtuales.

Palabras claves: Conocimiento tecnológico-pedagógico-contenido (TPACK); inglés como lengua extranjera (EFL); integración tecnológica.

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Explorando o conhecimento tecnológico, pedagógico e de conteúdo (TPACK) no ensino do inglês como língua estrangeira.

RESUMO

Este artigo apresenta os resultados de uma investigação que investiga como os professores de línguas estrangeiras que trabalham em contextos de educação a distância e virtual aplicam o Conhecimento Tecnológico, Pedagógico e de Conteúdo (TPACK) nas suas práticas de ensino. Enquadrados pelo modelo TPACK (Mishra & Koehler, 2006), os investigadores examinaram as oportunidades e limitações que os professores enfrentam ao integrar ferramentas em contextos instrucionais autênticos. Foi implementado um método misto: foi utilizado um questionário para quantificar a percepção da integração do TPACK, e as entrevistas semiestructuradas exploraram as percepções e experiências dos professores com maior profundidade. Os resultados demonstraram uma orientação geral positiva em relação à tecnologia educativa; no entanto, os participantes relataram barreiras persistentes, particularmente a preparação limitada e específica para o contexto da pedagogia informada pelo TPACK e o acesso desigual a recursos tecnológicos e apoio institucional. Estes resultados sugerem que a aplicação eficaz do TPACK no ensino de línguas online e a distância requer mais do que a competência tecnológica dos professores; Difere também em termos de orientação pedagógica contínua, alinhamento curricular e condições organizacionais que permitem a utilização significativa da tecnologia. Os resultados deste estudo fornecem informações úteis para a formação e desenvolvimento profissional dos professores, destacando a necessidade de formação específica e contextualizada em TIC para o ensino de línguas estrangeiras, especialmente em programas universitários de ensino a distância e virtual.

Palavras-chave: Conhecimento Tecnológico Pedagógico do Conteúdo (TPACK); Inglês Língua Estrangeira (EFL); Integração de tecnologia.

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INTRODUCTION

The importance of English language proficiency has grown considerably in the modern era. English has become a pivotal instrument influencing numerous facets of global society. The widespread use of English in areas such as science, education, business, technology, and

international communication has consolidated its position as a global language (Crystal, 2003). In this context, English plays a key role in facilitating cross-cultural communication and expanding opportunities for personal, academic, and professional development (Hossain, 2023).

At the same time, contemporary education systems are experiencing profound transformations driven by rapid technological advancement. The integration of digital technologies into teaching and learning processes has significantly altered the ways in which knowledge is constructed, shared, and accessed. These transformations became particularly evident during the COVID-19 pandemic, which accelerated the adoption of online and distance education modalities and required teachers to adapt their pedagogical practices to technology-mediated environments (Rapanta et al., 2021; Hollander, 2021).

In language education, technological development has generated new opportunities to support learning processes and enhance student engagement. Technology-mediated approaches such as Computer-Assisted Language Learning (CALL) and, more recently, artificial intelligence (AI)-based tools have demonstrated considerable potential for improving language acquisition, facilitating individualized learning experiences, and promoting students' motivation and autonomy (Jiang, 2022; Luo & Qiu, 2024; Negoescu & Mitrulescu, 2023). These tools can provide adaptive content, automated feedback, and interactive learning environments that support the development of language skills such as speaking, writing, and listening.

However, the effective integration of digital technologies in education depends largely on teachers' professional competencies and their ability to make pedagogically informed decisions about the use of technological tools. Several studies have emphasized that the successful implementation of educational technologies requires not only technical knowledge but also pedagogical and disciplinary understanding that enables teachers to integrate digital resources meaningfully into their instructional practices (Voogt et al., 2012; Redecker, 2017; Hidalgo et al., 2020). In the context of English as a Foreign Language (EFL) teaching, this integration is particularly relevant because language learning requires interactive, communicative, and context-sensitive pedagogical strategies.

Within this context, the Technological Pedagogical Content Knowledge (TPACK) framework has emerged as one of the most influential models for understanding how teachers integrate technology into their teaching practices. Originally proposed by Mishra and Koehler (2006), the TPACK framework conceptualizes teachers' knowledge as the dynamic interaction among three core domains: Content Knowledge (CK), which refers to knowledge of the subject matter; Pedagogical Knowledge (PK), which involves teaching strategies and learning processes; and Technological Knowledge (TK), which encompasses the ability to use digital tools and technologies. The intersections among these domains give rise to additional knowledge areas that enable teachers to design and implement technology-supported learning experiences effectively (Schmidt et al., 2009; Voogt et al., 2012).

The growing relevance of artificial intelligence and digital platforms in education has further expanded the significance of the TPACK framework. AI-based tools such as chatbots, grammar correction software, adaptive language platforms, and learning analytics systems are increasingly used in foreign language instruction to support feedback, personalize learning pathways, and facilitate communicative practice (Popenici & Kerr, 2017; Onesi et al., 2024; Xu, 2024). Nevertheless, the effective use of these tools requires teachers to develop integrated competencies that combine technological knowledge with pedagogical and linguistic expertise.

This challenge is particularly evident in distance and virtual education environments, where instructional design, communication patterns, and assessment processes are largely mediated by digital technologies. In such contexts, teachers must be able to align technological tools with pedagogical objectives and linguistic content to create meaningful learning experiences that support language development.

In response to these challenges, the present study investigates how teachers of English as a Foreign Language working in distance and virtual university programs enact Technological Pedagogical Content Knowledge (TPACK) in their teaching practices (Thompson & Mishra, 2007). The study specifically examines the opportunities and challenges teachers encounter when integrating digital technologies and AI-supported tools into their instructional practices.

To address this objective, the research adopted the TPACK framework (Mishra & Koehler, 2006) as the conceptual foundation and employed a mixed-methods design that combined survey data with semi-structured interviews. The participants were 80 foreign language teachers working in distance and virtual university programs in Bogotá. Through this approach, the study seeks to contribute to a deeper understanding of how teachers integrate technology, pedagogy, and content in technology-mediated language education and to provide insights that may inform teacher training and professional development initiatives in online and distance learning contexts.

THEORETICAL ASPECTS

Digital competence and technology integration in education

The rapid development of digital technologies has significantly transformed educational environments, generating new opportunities and challenges for teachers and students. In contemporary education systems, the integration of technological resources has become an essential component of teaching and learning processes, requiring educators to develop digital competencies that enable them to use technology effectively in pedagogical contexts. Educational policies and international frameworks have increasingly emphasized the importance of digital competence as a key element in modern teaching practice (Redecker, 2017).

At the international level, several initiatives have highlighted the importance of preparing teachers to work in digitally mediated learning environments. The development of digital competencies involves not only technical skills but also the capacity to design innovative learning activities, evaluate digital resources critically, and promote students' digital literacy (European Parliament & Council, 2006; Instituto Cervantes, 2012). In this regard, teachers are expected to integrate technological tools into their pedagogical practices in ways that enhance learning outcomes and foster student engagement.

From a sociocultural perspective, learning is understood as a process mediated by social interaction and cultural tools. According to the sociocultural theory proposed by Lev Vygotsky (1980), cognitive development occurs through interaction with others and through the use of mediating artefacts that support knowledge construction. In contemporary educational settings, digital technologies can function as such mediating tools, facilitating communication, collaboration, and access to information. Consequently, the integration of technological resources into educational practices can expand opportunities for interactive and collaborative learning experiences.

Research in the field of educational technology has demonstrated that teachers who possess strong digital competencies are better able to design innovative learning environments and integrate technological tools effectively into their instructional practices (Hidalgo et al., 2020). Therefore, the development of digital competence has become a fundamental component of teacher education and professional development programs.

Artificial intelligence and digital technologies in language education

The increasing availability of digital tools has created new possibilities for enhancing language teaching and learning processes. In recent years, the emergence of artificial intelligence (AI) technologies has further expanded the potential of digital resources in education. Artificial intelligence can be broadly defined as the capacity of computer systems to perform tasks that typically require human intelligence, such as pattern recognition, data analysis, and adaptive decision-making (Morandín Ahuerma, 2022).

In educational contexts, AI-based technologies have been implemented through intelligent tutoring systems, automated feedback tools, adaptive learning platforms, and conversational agents designed to support student learning. These technologies allow learners to receive personalized feedback, engage in interactive learning experiences, and practice language skills in flexible and autonomous ways (Jiang, 2022; Xu, 2024).

Recent research has highlighted the potential of artificial intelligence to enhance language learning processes by providing individualized learning paths and immediate feedback to students. AI-supported language learning platforms can analyze learners' responses and adapt instructional content according to their performance, which contributes to improving motivation and learning outcomes (Luo & Qiu, 2024; Negoescu & Mitulescu, 2023).

However, the integration of artificial intelligence in education also presents significant challenges. Scholars have emphasized that technology alone does not guarantee improved learning outcomes; rather, its effectiveness depends largely on how teachers incorporate technological tools into pedagogically meaningful instructional practices (Popenici & Kerr, 2017). Furthermore, systematic reviews of AI applications in higher education indicate that educators must develop competencies that allow them to evaluate and integrate these technologies responsibly and effectively (Zawacki-Richter et al., 2019).

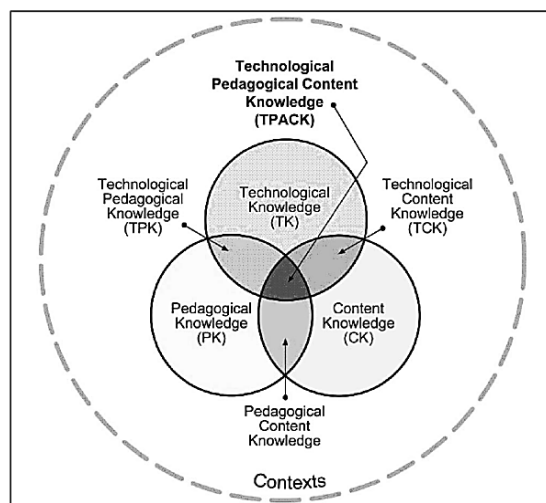
These considerations highlight the need for teachers to develop integrated knowledge that combines technological skills with pedagogical expertise and disciplinary understanding.

Technological Pedagogical Content Knowledge (TPACK)

One of the most influential frameworks for understanding technology integration in education is the Technological Pedagogical Content Knowledge (TPACK) model. The framework was originally proposed by Punya Mishra and Matthew J. Koehler as an extension of Shulman's concept of Pedagogical Content Knowledge. The model emphasizes the complex relationships between technology, pedagogy, and subject matter knowledge in contemporary teaching contexts (Mishra & Koehler, 2006; Thompson & Mishra, 2007).

Figure 1.

The components of the TPACK framework (graphic from <http://tpack.org>).



The TPACK framework conceptualizes teachers' knowledge as the interaction among three primary domains: Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK). Content Knowledge refers to teachers' understanding of the subject matter they teach, including concepts and theoretical foundations. Pedagogical Knowledge involves knowledge about teaching strategies, instructional design, and learning processes. Technological Knowledge refers to teachers' ability to use and evaluate technological tools in educational settings (Thompson & Mishra, 2007).

Beyond these three domains, the framework also highlights the intersections among them. Pedagogical Content Knowledge (PCK) refers to the ability to teach specific subject matter effectively; Technological Content Knowledge (TCK) refers to understanding how technology can represent and transform disciplinary content; and Technological Pedagogical Knowledge (TPK) refers to the capacity to adapt pedagogical strategies through technological tools. The integration of these domains results in Technological Pedagogical Content Knowledge (TPACK), which represents the comprehensive knowledge teachers need to design effective technology-enhanced learning experiences (Schmidt et al., 2009).

Since its introduction, the TPACK framework has been widely applied in studies examining teachers' competencies for integrating digital technologies in educational practice. Research has shown that teachers' TPACK competencies are influenced by factors such as professional training, teaching experience, and institutional support (Lux et al., 2011; Liang et al., 2013; Kazu & Erten, 2014). These studies indicate that teachers who develop stronger techno-pedagogical competencies are better prepared to integrate digital tools into their teaching practices.

Literature reviews have also emphasized the relevance of the TPACK framework as a conceptual model for analyzing technology integration in education. For instance, studies analyzing the development of teachers' technological competencies highlight that TPACK provides a comprehensive perspective for understanding the complex interactions between technological, pedagogical, and disciplinary knowledge (Voogt et al., 2012).

In the specific context of English as a Foreign Language (EFL) teaching, research has shown that effective technology integration requires teachers to align technological tools with pedagogical objectives and linguistic content. Empirical studies have demonstrated that teachers who possess strong TPACK competencies are more capable of designing innovative language learning activities and facilitating communicative learning environments supported by digital technologies (Nazari et al., 2019; Aniq & Draijati, 2019).

Similarly, research examining professional development programs focused on technology integration indicates that teacher training initiatives can significantly contribute to strengthening educators' techno-pedagogical competencies (Mohammadi & Moradi, 2017). Other studies emphasize the importance of preparing teachers to adopt reflective teaching practices and integrate digital tools effectively into their pedagogical strategies (Hepp et al., 2015; Cely Betancourt et al., 2024).

Recent research also highlights that teachers often face challenges when attempting to integrate technology into language education, including limitations related to technological infrastructure, access to resources, and institutional support (Nurdin et al., 2023). These challenges are particularly relevant in distance and virtual learning environments, where teaching and learning processes rely heavily on digital technologies.

In this context, the TPACK framework provides a valuable theoretical lens for analyzing how teachers integrate technological tools, pedagogical strategies, and disciplinary knowledge in digitally mediated learning environments. By examining teachers' techno-pedagogical competencies, it becomes possible to better understand the opportunities and challenges associated with the use of emerging technologies in foreign language education.

Methodology

This study followed a mixed method design combining a survey to qualify teachers' perceived TPACK integrations with semi-structured interviews to deepen understanding of their experiences. The combination of both types of data allowed for a more comprehensive understanding of the integration of TPACK into classroom practice which provided robust empirical evidence and a deeper exploration of the research problem (Nair & Prem, 2020). The objective was to examine how RFL teachers in distance and virtual settings enact Technological Pedagogical Content Knowledge (TPACK) in their teaching practices to identify challenges and opportunities associated with this integration. The research question that guided

this study was: *How do EFL teachers integrate Technological Pedagogical Content Knowledge (TPACK) in their teaching practices, and what challenges and opportunities do they encounter?*

Instruments were reviewed by experts in educational research to establish content validity, ensuring that the items were clear and coherent with the TPACK constructs and the study objectives. Instruments were piloted with a small group of participants to check comprehensibility, timing and functionality of response options and identify ambiguity or redundant items. The validation and piloting process strengthened the methodological rigor of the study by improving the reliability and interpretation of the data collected and by reducing measurement error before full-scale implementation.

Participants

The participants comprised 80 foreign language teachers who deliver English courses as part of virtual and distance learning programs in Bogotá. The demographic composition of the sample was as follows: 48% of the subjects were female, and 52% were male. 89% had master's degrees and 11% had doctoral degrees. Furthermore, it is noteworthy that 78% of these respondents had accumulated over a decade of experience in teaching online or distance learning programs, or both. Furthermore, 22% of respondents reported possessing between seven and ten years of professional experience. The current employment status of the respondents indicates that 74% of them are engaged in distance learning programs, while the remaining 26% are involved in online programs.

Researchers' role

Researchers acted as the primary instruments for the qualitative strand on the study, designing the survey and interview protocol, coordinating participants recruitment, conducting the semi-structured interviews, and leading data analyst and interpretations. The researchers did not hold a prior supervisory or evaluative relationship with participants. Throughout the process, the researchers maintained a reflexive stance to minimize bias, documenting analytic decisions and ensuring that interpretations were grounded in participants' accounts.

Ethical Issues

Participation was voluntary, anonymity and confidentiality were emphasized through the use of codes and data atomization, all records were stored securely with restricted access. To reduce potential power imbalances, participants were informed that their decision to participate or withdraw at any time would have no academic or professional consequences. All participants provided informed consents included as part of the survey and written consents for interviews.

Data analysis

Quantitative survey data were analyzed using descriptive statistics using SPSS software through a sequence of procedures aimed at describing and organizing teachers' responses regarding perceived TPACK integration. Open-ending survey responses and semi-structured interviews were analyzed through thematic analysis, following an iterative procedure of familiarization, initial coding, and focus coding to generate categories and overarching themes aligned with the study objectives and the TACK framework. The resulting themes were compared with quantitative survey patterns to triangulate findings and strengthen interpretations of EFL teachers' TPACK enactment in distance and virtual education context.

Findings

Technological Knowledge (TK)

The Technological Knowledge (TK) domain shows a favorable profile, with most of the responses concentrated in the "Always" and "Almost always" categories. These results show an overall solid digital self-efficacy regarding professional updating and instrumental tasks.

Table 1.*Technological Knowledge (TK)*

Indicador	Always	Almost always	Sometimes	Almost never	Never
I feel confident selecting and using AI powered language platforms (e.g., chatbots, adaptive apps) that offer real time feedback to enhance student motivation and autonomy.	33%	30%	30%	7%	0%
I can independently learn how to operate new educational technologies such as grammar correction software and troubleshoot common issues that arise during lessons.	44%	44%	11%	0%	0%
I actively explore and evaluate emerging digital tools that support individualized learning pathways for my English learners.	33%	44%	22%	0%	0%
I know how to set up and manage online environments where students can practice speaking and listening skills with AI tutors.	26%	37%	26%	11%	0%
I regularly update my skills in using multimedia and mobile technologies to provide students with autonomous, self, paced practice.	37%	37%	22%	4%	0%
I can judge which technological tools best align with specific language skill objectives (speaking, writing, listening) in my lesson plans.	44%	26%	26%	4%	0%
I am comfortable integrating video, audio, and interactive simulation tools to create engaging, technology rich tasks.	52%	26%	7%	15%	0%
I have experience configuring adaptive learning platforms to deliver targeted exercises based on each student's performance.	37%	26%	22%	11%	4%

Note: The table shows the results found in the survey on teachers' Technological Knowledge (TK)

According to the survey, there is strong independence in the use of technology, especially in their ability to learn new technologies by themselves and solve technical problems (Item 2), which received the highest level of agreement with 88% reporting "Always/Almost always". Additionally, high levels of self-confidence were reported in the use of AI tools (Item 1) and in exploring and training tools for individualized learning (Item 3), with 77% answering "Always/Almost always" in both items. Despite the percentage of "Sometimes" responses (22.3%), this suggests that its use in practice depends more on institutional stability and available resources than on low competence.

On the other hand, more complex tasks requiring advanced levels of personalization, including the management of AI mediated environments for speaking and listening practice (Item 4) and working with adaptive platforms for different exercises (Item 8) had lower agreement (63% "Always/Almost always") and higher low-frequency responses (e.g., "Almost never" = 11% in both items; "Never" = 4% in Item 8), indicating vulnerabilities in the organization of techno-pedagogical practices and adaptation based on data.

At length, Finally, while multimedia integration (Item 7) had the highest “Always” rate (52%), the presence of “Almost never” responses (15%) suggests different levels of capacity across teachers, showing that the main challenge is not using basic technology, but improving more strategic and adaptive use through focused professional training and supportive institutional conditions.

Pedagogical Knowledge (PK)

Pedagogical Knowledge (PK) domain evidence a mixed profile, where solid instructional planning coexists with gaps in digital analytics and AI mediated feedback. This by itself highlights the discrepancy between traditional instructional design and the emerging demands of data-driven assessment. Despite this deficit in digital analytics, participants stand out with their strength related to the proficiency in classroom management.

Table 2.

Pedagogical Knowledge (PK)

Indicador	Always	Almost always	Sometimes	Almost never	Never
I design learning activities that leverage AI driven feedback loops to sustain student motivation and self-directed practice.	19%	22%	33%	22%	4%
I select teaching strategies that foster learner autonomy, such as guided discovery tasks supported by technology.	37%	37%	15%	11%	0%
I adapt my instructional approaches in real time, using student performance data from digital tools to inform pedagogical decisions.	33%	37%	26%	4%	0%
I employ collaborative, technology mediated tasks (e.g., peer review using online annotation) to enhance classroom interactivity.	44%	30%	7%	19%	0%
I regularly reflect on and refine my use of pedagogical models when integrating technology into lesson delivery.	33%	44%	11%	11%	0%
I facilitate student centered discussions that draw on data generated by AI tools to guide group work.	37%	19%	26%	15%	4%
I use formative assessment strategies, informed by digital analytics, to adjust teaching methods for diverse learner needs.	41%	15%	15%	19%	11%

Note: Percentages indicate the distribution of responses across the five-point frequency.

Participants reported consistently high agreements with pedagogical practices focused on flexibility and learner autonomy, such as choosing strategies that support student self-regulation (Item 2: 74% “Always/Almost always”), as well as adapting instruction in real time (Item 3: 70%) and thinking carefully about how pedagogical models are used (Item 5: 77%), which, taken together, reflect a PK based on didactic principles and methodological coherence in technology-rich environments.

Nevertheless, the key challenges related to PK include creating sustained feedback systems and making assessment decisions based on analytics. Feedback systems supported by artificial intelligence (Item 1) showed the lowest level of high agreement (41%) and a notable rate of low frequency responses (26% “Almost never/Never”). This shows difficulty turning automated feedback into clear teaching processes. A similar pattern appears in analytics-based formative assessment (Item 7), where responses were divided (56% high frequency vs. 30% “Almost never/Never”), and in Item 4, where strong overall agreement (74%)

appeared together with a notable “Almost never” rate (19%), indicating different levels of use.

Overall, the evidence shows that the main issue is not willingness, but the ability to use analytics to make teaching decisions. This highlights the need for professional training in feedback systems, understanding learning analytics, and evidence-based teaching when using AI.

Content Knowledge (CK)

The Content Knowledge (CK) domain demonstrates that there is a highly consolidated disciplinary mastery among participants, which results consistent with their level of expertise; meaning they are provided with a strong foundation for informed curricular decisions.

Table 3.

Content Knowledge (CK)

Indicator	Always	Almost always	Sometimes	Almost never	Never
I have a deep understanding of English language structures (grammar, vocabulary, pronunciation) and know how to sequence them for optimal learner uptake.	89%	11%	0%	0%	0%
I can clearly explain complex linguistic concepts, using examples drawn from AI generated exercises or authentic corpora.	67%	15%	15%	0%	4%
I select content that integrates cultural context and reflects real world language use facilitated by digital platforms.	52%	41%	4%	0%	4%
I stay current with curriculum standards and adapt content to leverage technology supported materials (e.g., interactive corpora).	48%	26%	15%	11%	0%
I know how to embed adaptive speaking, writing, and listening tasks within the language syllabus to strengthen skill development.	56%	26%	7%	11%	0%
I can design content modules that align with the feedback patterns provided by AI grammar correction and pronunciation tools.	37%	41%	15%	7%	0%
I appreciate the interplay between language form, meaning, and use and can integrate that triad into multimedia lessons.	48%	37%	11%	4%	0%

Note: The table shows percentages and distribution of responses across the five-point frequency scale.

Results indicate strong Content Knowledge (CK) among participants, as Item 1 shows complete agreement regarding deep understanding and organization of English linguistic structures (100% “Always/Almost always”), suggesting strong knowledge in grammar, vocabulary, and pronunciation that supports instructional coherence. This strength is reinforced by high agreement for explaining difficult concepts through AI-generated exercises or real language examples (Item 2: 82%) and for designing content that integrates sociocultural contexts via digital platforms (Item 3: 93%), pointing to a strong mix of declarative (“knowing what”) and procedural (“knowing how”) knowledge.

Nonetheless, items that require a closer connection between Content Knowledge (CK) and technology-based curriculum design show greater differences: curriculum adaptation through platforms (Item 4) shows a more mixed pattern (74% high agreement, with 15% “Sometimes” and 11% “Almost never”), and aligning modules with system-generated

feedback (Item 6) remains inconsistent for some participants (78% high agreement, with 15% "Sometimes" and 7% "Almost never").

Technological Pedagogical Knowledge (TPK)

The Technological Pedagogical Knowledge (TPK) domain indicates a competence in development, characterized by consistent strengths in technology, however with noticeable differences in how it is implemented.

Table 4.

Technological Pedagogical Knowledge (TPK)

Indicador	Always	Almost always	Sometimes	Almost never	Never
I incorporate motivational scaffolds, such as gamified elements and AI, powered chatbots, design communicative tasks that promote learner interaction, deliver immediate feedback, and supports engagement.	48%	19%	19%	15%	0%
I design activities where students employ digital portfolios and automated feedback to reflect on their own progress.	33%	19%	11%	22%	15%
I adapt pedagogical strategies, such as task, based learning, so they harness the strengths of specific technologies (e.g., speech recognition too).	44%	11%	26%	11%	7%
I blend synchronous video conferencing with collaborative online whiteboards to facilitate dynamic, technology enriched instruction.	30%	22%	26%	11%	11%
I integrate learning management systems that track student engagement and support differentiated grouping.	33%	30%	15%	19%	4%
I develop flipped classroom modules in which students prepare with AI driven exercises before in person sessions.	30%	26%	22%	11%	11%
I evaluate how different technological affordances (e.g., branching scenarios in apps) impact student motivation and learning.	37%	26%	26%	11%	0%
I continually refine my pedagogical approach based on analytics from digital learning environments.	44%	22%	22%	7%	4%

Note: The table shows percentages and distribution of responses across the five-point frequency scale.

Results for Technological Pedagogical Knowledge (TPK) indicate that many participants can integrate technology into pedagogical goals such as engagement and reflective improvement. Item 1 shows relatively high agreement for incorporating motivational scaffolds and AI chatbots into communicative tasks (67% "Always/Almost always"), while analytics-informed improvement of pedagogy (Item 8) also reached a similar level of agreement (66%). Adapting task-based learning (TBL) frameworks through technology (Item 3) received moderate agreement (55%), although the proportion of "Sometimes" responses (26%) indicates that its use in practice may be context dependent.

Simultaneously, strong difficulties appear in practices that require advanced infrastructure and skills in using data. Digital portfolios and automated feedback (Item 2) show a marked split in responses (52% high frequency vs. 37% "Almost never/Never"), and both synchronous collaborative tools (Item 4) and AI-supported flipped models (Item 6) show only

moderate high frequency use (52% and 56%, respectively), along with a notable “Never” rate (11% in both). LMS based tracking of engagement (Item 5) also shows different levels of use (63% high frequency, 23% low frequency). In general, these patterns suggest that the main challenge is moving from isolated technology supported activities to more coherent, data-based instructional systems. This highlights the need for focused professional development in digital assessment design and skills for understanding learning analytics, to stabilize the use of TPK in practice.

Technological Content Knowledge (TCK)

In the Technological Content Knowledge (TCK) domain, the results reveal a clear contrast: teachers possess the skills to develop interactive digital content, yet they lack the expertise to utilize learning analytics for curricular planning. While they successfully create simulations and quizzes, they do not yet use data from digital platforms to guide their teaching decisions.

Table 5.

Technological Content Knowledge (TCK)

Indicator	Always	Almost always	Sometimes	Almost never	Never
I maintain up to date knowledge of research on technology mediated language acquisition to inform content choices.	41%	26%	19%	15%	0%
I select AI tools that align precisely with the language content I teach for example, using pronunciation apps to reinforce phonemic contrasts.	41%	19%	19%	19%	4%
I create interactive content (quizzes, simulations) that leverage digital platforms to illustrate and practice key grammatical structures.	59%	22%	11%	7%	0%
I integrate corpus, based concordances and adaptive vocabulary trainers to deepen students’ content knowledge.	30%	33%	11%	11%	15%
I use multimedia projects such as student produced podcasts to reinforce listening and speaking content in an authentic context.	41%	19%	15%	19%	7%
I employ writing enhancement software to give students real time feedback on composition and style relevant to course outcomes.	26%	30%	15%	15%	15%
I ensure digital content (videos, articles, exercises) is scaffolded to match students’ current proficiency and content objectives.	44%	33%	11%	7%	4%
I adapt open educational resources with embedded AI features to supplement my core language syllabus.	30%	26%	19%	19%	7%
I leverage analytics from content focused platforms to identify and address persistent learner errors in the curriculum.	26%	26%	15%	22%	11%

Note: The table shows percentages and distribution of responses across the five-point frequency scale.

Findings for Technological Content Knowledge (TCK) indicate the strongest agreement for creating interactive digital content (Item 3: 81% “Always/Almost always”), suggesting that participants can accurately translate linguistic knowledge into technology-mediated experiences that support grammatical practice. A strong base for informed technology use is also evident, as staying updated with the latest language acquisition research (Item 1: 67%)

and choosing content-aligned tools (Item 2: 60%) received moderate-to-high agreement, while scaffolding digital content according to levels and objectives (Item 7: 77%) reinforces a key TCK feature: prioritizing pedagogical effectiveness over simple digital transfer.

Nonetheless, agreement decreases as tasks require higher technical complexity and diagnostic use of technology, especially when integrating language databases, search tools, and AI-integrated resources (Items 4 and 8: 63% and 56% high agreement), alongside noticeable low-frequency responses. The most notable vulnerability concerns the use of analytics to improve instruction: real-time writing support software (Item 6: 56%) and especially using content-centered analytics to address learning gaps (Item 9: 52%) show the lowest levels of high agreement, with Item 9 presenting a high rate of low-frequency responses (33% "Almost never/Never"). For the most part, the pattern suggests that digital content creation is recognized, while data informed content organization, using language databases, automated feedback, and analytics to improve sequencing and address learning errors shows different levels of use, indicating a need for professional development that strengthens practical language data use and evidence based instructional adjustment.

Pedagogical Content Knowledge (PCK)

The Pedagogical Content Knowledge (PCK) domain demonstrates a solid and consistent performance. Most items are centralized in the "Always" and "Almost always" categories, indicating a stable integration between linguistic content knowledge and effective EFL didactic decisions. Of course, the results highlight a strong commitment to assessment of coherence and conceptual depth.

Table 6.

Pedagogical Content Knowledge (PCK)

Indicator	Always	Almost always	Sometimes	Almost never	Never
I design lesson plans that integrate cultural themes into language instruction, using pedagogical methods suited to EFL learners.	52%	26%	19%	4%	0%
I apply task, based teaching approaches that balance communicative objectives with explicit form focus as needed.	44%	48%	4%	4%	0%
I use formative checks such as quick polls or exit tickets to gauge content comprehension and adjust teaching accordingly.	30%	33%	19%	15%	4%
I guide students through problem solving activities that connect linguistic form to authentic language use.	37%	48%	11%	0%	4%
I scaffold complex content (e.g., academic writing conventions) with step-by-step pedagogical support.	41%	48%	7%	0%	4%
I facilitate learner reflection on both process and product, helping students internalize content through metacognitive strategies.	48%	37%	11%	4%	0%
I align assessment tasks with both content objectives and pedagogical aims, ensuring meaningful evaluation.	59%	37%	4%	0%	0%
I foster critical discussions about language usage and cultural context to deepen content understanding.	59%	30%	11%	0%	0%

Note: The table shows percentages and distribution of responses across the five-point frequency scale.

Pedagogical Content knowledge (PCK) shows a strong alignment between instructional goals, methodology, and assessment. This is evidenced in the item 7, where teachers reported a very high agreement in terms of aligning assessments with content objectives (Item 7: 96% "Always/Almost always"), connected with item 8, which highlights the importance on fostering critical discussions on language use and culture (Item 8: 89%). Furthermore, teachers agreed with the application of task-based learning (TBL) to balance communicative objectives with attention to form (Item 2: 92%). These findings suggest that PCK functions as a structuring competence that supports purposeful planning and meaningful learning. Nonetheless, there are some challenges that stand out in the systematic use of active formative assessment and real-time instructional adjustment. This is evident in the item 3's variability (63% high frequency, 19% "Sometimes," and 19% "Almost never/Never"), which exposes the quick formative checks such as polls or exit tickets. In consequence, we may infer that "micro" formative assessment practices are not consistently embedded across the group. Besides, similar results are found in culturally oriented integration (Item 1: 78% high, 19% "Sometimes") and metacognitive reflection (Item 6: 85% high, 11% "Sometimes"). In summary, we can determine that foundational PCK appears to be consolidated, although the key priority is strengthening methodological consistency. To achieve it, it is essential to integrate short, routine formative feedback cycles into everyday teaching, making evidence-based adjustments part of classroom practice.

TPACK (Technological Pedagogical Content Knowledge)

Findings in the TPACK domain are composed of several items that intend to show the simultaneous integration of technology, pedagogy, and content among the participants. The findings in this category describe a generally positive attitude towards the integration of these aspects. Nevertheless, it also indicates a variable depending on the specific practice required. For instance, several items present a consistent high agreement in the "Always" and "Almost always" categories, particularly to situations subject to tangible, goal, oriented integration.

Table 7.

Technological Pedagogical Content Knowledge

Indicator	Always	Almost always	Sometimes	Almost never	Never
I design comprehensive learning modules that seamlessly integrate AI driven tools, pedagogical strategies, and content goals to maximize student engagement.	30%	22%	33%	15%	0%
I plan lessons in which technology (e.g., adaptive listening platforms) and pedagogy (e.g., scaffolding) work together to reinforce language content.	37%	30%	22%	11%	0%
I assess how real time feedback from digital tools influences student motivation and learning outcomes, then adapt my instruction.	26%	33%	15%	22%	4%
I create materials that harmonize multimedia content, interactive tasks, and evidence, based on teaching methods in a single cohesive framework.	33%	33%	11%	22%	0%
I tailor technological integrations such as flipped classroom and gamified exercises to fit specific content objectives.	44%	30%	15%	11%	0%

I continuously evaluate and refine the balance between technological affordances, pedagogical effectiveness, and content accuracy.	41%	33%	22%	4%	0%
I use data from integrated platforms to differentiate instruction and provide targeted support for individual learners.	33%	30%	22%	11%	4%
My teaching practice reflects a dynamic synergy of technology, pedagogy, and content knowledge, driving both motivation and skill acquisition.	44%	30%	22%	4%	0%

Note: The table shows percentages and distribution of responses across the five-point frequency scale.

Overall, TPACK results revealed that participants have a solid foundation for goal-oriented integration. This is particularly evidenced in the implementation of methodologies such as flipped classroom and gamification that are adjusted to align with content objectives (Item 5: 74% “Always/Almost always”); in addition to the self-reported synergy among technology, pedagogy, and content (Item 8: 74%), and the lesson planning that requires scaffolding and technology to work simultaneously to reinforce content learning (Item 2: 67%). These patterns indicate that teachers do not treat technology only as an instrument, but rather as part of didactic decision-making linked to learning goals. Nevertheless, TPACK adoption decreases when this dimension requires fully simultaneous and systematized integration. To illustrate, the design of comprehensive modules that seamlessly combine AI, pedagogy, and content goals (Item 1) only showed moderate high agreement (52%), followed by a substantial “Sometimes” (33%) and “Almost never” (15%) responses. These findings suggest that there is an inconsistency in its application, most likely due to design complexity and time restrictions.

The highest concern in TPACK dimension involves the use of real-time digital feedback to sustain motivation and adapt instruction (Item 3), which records lower agreement (59%) and a notable low-frequency floor (26% “Almost never/Never”); while harmonizing multimedia with interactive tasks (Item 4) also reveals uneven implementation (66% high frequency, yet 22% “Almost never”). Added to it, it was found that data-supported differentiation remains an area of improvement (Item 7: 63% high frequency, with 15% “Almost never/Never”). In summary, these findings reveal a need for prioritizing standardized design templates, as well as training in learning analytics and feedback-loop interpretation as part of the professional development component. By focusing on these factors, teachers enable their ability to move from isolated technology usage toward coherent, monitorable, and evaluable instructional sequences.

Qualitative analysis

The interviews were guided by questions designed to elicit teachers integrate technology in distance and virtual EWFL teaching through the lens of TPACK. Participants were asked to describe 1) Which digital AI tools they use and for what purposes (TK); 2) how technology shapes their planning, classroom management, and learning activities (PK/TPK); 3) how the define and prioritize linguistic content, skills, and objectives (CK/PCK); 4) how technology supports the representation and practice of language connect (TCK); and 5) what challenges, opportunities and ethical concerns emerge when integrating AI and ICT in their instructional decision (TPACK).

Table 8.

Condensed interview themes through a TPACK lens in distance/virtual EFL teaching.

Cluster (TPACK Lens)	Core subtheme	Evidence (quote)
Technology for language production (TK/TCK)	AI as tutoring/support for speaking.	"I have used AI, such as ChatGPT and Gemini, as a support tool and as a speaking tutor" (Interviewee 01).
Technology for feedback cycles (TCK/TPK)	Automated feedback enabling iterative improvement.	Students "receive automated-structured feedback and engage in iterative revision processes" (Interviewee 2).
Pronunciation as a tool-mediated target (CK/TCK).	Voice recording + feedback as criteria for tool selection.	"If the lesson focuses on pronunciation, I choose tools that provide voice recording and feedback" (Interviewee 1).
Planning as experience design (PK)	Interactive, multimodal lesson planning.	"My lesson planning... are more interactive, multimodal, and enjoyable" (Interviewee 1).
Adaptive instructional design (PK/TPK)	Lesson plans as flexible designs responsive to needs.	Lesson plans "are no longer static documents but flexible learning designs that respond to students' needs..." (Interviewee 2).
Engagement and attention management (PK)	Games/warm-ups to gain attention and build climate.	"I like to start my classes with games because... gaining their attention... is not easy" (Interviewee 5).
Sequenced integration (TPK/TPACK)	Technology embedded in guided instructional sequences.	"I embedded it within a pedagogically guided sequence..." (Interviewee 2).
Product-oriented tasks (TPK)	AI used to generate learning products/evidence.	"End products are result of students using AI..." (Interviewee 4).
Content-specific pedagogy (PCK)	Flipped classroom + scaffolding + formative feedback.	"Flipped classroom... review grammar tenses at home" (Interviewee 1); "explicit instruction... scaffolded practice... continuous formative feedback..." (Interviewee 2).
Precision in linguistic objectives (CK/PCK)	Specific objectives guiding teaching/assessment.	"The linguistic objective must be sufficiently specific... 'develop ability to use conditional structures...'" (Interviewee 2).
Balanced tool use (TPACK)	Avoiding tool saturation.	"Not every single class can finish with a Kahoot game" (Interviewee 5).
Ethics and responsible AI use (TPACK)	Plagiarism concerns + authentic task design.	Need training on "how to detect and avoid plagiarism when students use AI" (Interviewee 1); institutions "neglecting... ethical considerations" (Interviewee 2).

Note: Clusters reflect overlaps across TPACK domains; quotes are presented with verbatim as provided by participants.

The condensed interview evidence portrays TPACK implementation as a largely purposeful and pedagogically grounded integration of technology in distance/virtual EFL teaching. Teachers shared their preference to use AI to support language production, especially when it involves tutoring functions (Interviewee 01), and they also value automated feedback as a mechanism for iterative improvement (Interviewee 2). This includes tool-mediated support for pronunciation via voice recording and feedback (Interviewee 1).

In terms of pedagogy, the lesson planning factor is described as an interactive, multimodal experience design (Interviewee 1), and as a flexible instructional architecture that responds to learners' needs (Interviewee 2). In relation to this, the use of games and warm-ups stands out as a strategy to manage attention and classroom climate (Interviewee 5). Besides, integration is further evidenced through sequenced, guided use of technology (Interviewee

2), and product-oriented tasks that involve AI to support learning evidence (Interviewee 4), supported as well by content-specific strategies such as flipped classroom, scaffolding, and formative feedback (Interviewees 1–2), and by precise linguistic objectives that guide instruction and assessment (Interviewee 2). Furthermore, participants express their awareness of balance in tool use (Interviewee 5) and highlight the ethical concerns that rise around plagiarism and the need for authentic task design and institutional support for responsible AI use (Interviewees 1–2). This indicates that effective TPACK adoption involves not only technical and pedagogical alignment, but also ethical and organizational conditions.

DISCUSSION

The results of this study provide important insights into the ways in which English as a Foreign Language (EFL) teachers integrate technological tools into their pedagogical practices within distance and virtual learning environments. The findings suggest that teachers recognize the pedagogical value of digital technologies and demonstrate a willingness to incorporate them into their instructional strategies. However, the results also indicate that the effective integration of these tools depends largely on the development of integrated technological, pedagogical, and disciplinary competencies.

These findings are consistent with previous research highlighting the importance of the Technological Pedagogical Content Knowledge (TPACK) framework for understanding how teachers integrate technology into educational contexts. Studies examining the implementation of TPACK in higher education indicate that teachers who possess stronger techno-pedagogical competencies are more capable of designing innovative learning activities and effectively integrating digital resources into their teaching practices (Liang et al., 2013; Lux et al., 2011; Kazu & Erten, 2014). In this sense, the results of the present study reinforce the idea that the development of integrated knowledge domains plays a crucial role in facilitating meaningful technology integration in language education.

Similarly, the findings highlight the importance of teacher training and professional development in strengthening educators' ability to use technological tools effectively. Several studies have emphasized that continuous professional development programs contribute significantly to improving teachers' technological competencies and promoting the adoption of innovative pedagogical strategies (Mohammadi & Moradi, 2017). In line with these findings, the participants in the present study reported that institutional support and access to professional development opportunities are key factors influencing their capacity to integrate digital technologies into their teaching practices.

Another relevant finding of the study relates to the increasing presence of artificial intelligence technologies in educational contexts. The growing availability of AI-based tools has created new possibilities for enhancing language learning through personalized instruction, automated feedback, and adaptive learning environments. These findings align with recent research highlighting the transformative potential of artificial intelligence in higher education (Morandín Ahuerma, 2022). AI-supported technologies can facilitate individualized learning processes and provide students with opportunities to practice language skills in flexible and interactive environments.

However, despite the potential benefits of these technologies, the results also suggest that their effective implementation depends on teachers' ability to integrate them into pedagogically meaningful instructional designs. This perspective is consistent with previous studies emphasizing that technological innovation in education must be accompanied by the development of teachers' digital competencies and pedagogical knowledge (Cely Betancourt et al., 2024). Without adequate training and institutional support, the integration of emerging technologies may remain limited or superficial.

Furthermore, the study highlights several challenges associated with technology integration in distance and virtual learning environments. Participants reported difficulties related to technological infrastructure, access to digital resources, and the need for ongoing professional development. These findings coincide with previous research indicating that teachers often

face institutional and contextual barriers when attempting to integrate digital technologies into their teaching practices (Nurdin et al., 2023). Such challenges underscore the importance of developing comprehensive strategies aimed at strengthening teachers' technological competencies and providing adequate institutional support.

Overall, the findings of this study contribute to the growing body of literature examining the role of technology in language education and reinforce the relevance of the TPACK framework as a conceptual model for understanding technology integration in teaching practice. By analyzing teachers' experiences and perceptions in distance and virtual learning contexts, this research provides valuable insights into the opportunities and challenges associated with the use of digital technologies and artificial intelligence in foreign language education.

CONCLUSIONS

The present study examined the integration of technological, pedagogical, and content knowledge among English as a Foreign Language (EFL) teachers working in distance and virtual university programs. The findings reveal that teachers recognize the importance of integrating digital technologies into their teaching practices and demonstrate a positive disposition toward the use of technological tools to support language learning processes. However, the results also indicate that the effective use of these technologies depends largely on teachers' techno-pedagogical competencies and the availability of institutional support.

The analysis highlights the relevance of the Technological Pedagogical Content Knowledge (TPACK) framework as a valuable model for understanding how teachers combine technological, pedagogical, and disciplinary knowledge in technology-mediated learning environments. Consistent with previous studies, the results suggest that teachers who develop stronger integrated competencies are better prepared to design innovative learning activities and incorporate digital tools into their instructional strategies (Voogt et al., 2012).

Another important finding of this study relates to the growing role of emerging technologies, particularly artificial intelligence, in language education. AI-based tools offer opportunities to support personalized learning, provide automated feedback, and facilitate interactive learning experiences for students. Nevertheless, the successful implementation of these technologies requires educators to possess not only technological knowledge but also the pedagogical capacity to integrate them effectively into language teaching practices (Zawacki-Richter et al., 2019).

The study also highlights the importance of teacher training and professional development programs aimed at strengthening educators' digital competencies. Continuous professional development initiatives can play a crucial role in helping teachers adapt to rapidly evolving technological environments and develop innovative pedagogical approaches that respond to the needs of contemporary learners.

Despite its contributions, this study has certain limitations that should be acknowledged. The research focused on a specific group of university teachers working in distance and virtual programs in Bogotá, which may limit the generalizability of the findings to other educational contexts. Future research could expand the scope of analysis by including teachers from different institutions, educational levels, and geographic regions in order to obtain a broader understanding of technology integration in language education.

In conclusion, this study contributes to the growing body of research on technology integration in foreign language education by providing insights into how teachers enact Technological Pedagogical Content Knowledge in digitally mediated learning environments. The findings underscore the importance of strengthening teachers' techno-pedagogical competencies and promoting institutional strategies that support the effective integration of emerging technologies in language education.

STUDY LIMITATIONS

This study presents certain limitations that should be acknowledged when interpreting the results. First, the research was conducted with a specific group of English as a Foreign Language teachers working in distance and virtual university programs in Bogotá, which may limit the generalizability of the findings to other educational contexts or geographic regions. Additionally, the study relied on self-reported data obtained through surveys and interviews, which may be influenced by participants' perceptions and subjective interpretations. Future studies incorporating classroom observations or longitudinal research designs could provide a deeper understanding of how teachers enact technological pedagogical content knowledge in real teaching situations.

FUTURE RESEARCH

Future research could expand the scope of this study by examining technology integration and TPACK development among teachers from different educational levels, institutions, and cultural contexts. Comparative studies involving teachers from various countries or educational systems could provide valuable insights into how institutional conditions and technological infrastructures influence technology integration in language education. Furthermore, future investigations may explore the impact of emerging technologies, particularly artificial intelligence tools, on language teaching practices and student learning outcomes in virtual and hybrid educational environments.

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AUTHOR CONTRIBUTIONS

Paula Valentina Quecán Sánchez: Conceptualization, research design, data collection, data analysis, and manuscript writing.

Andrea Cardenas Coronado: Methodological design, data interpretation, critical review of the manuscript, and academic supervision.

Blanca Lucia Cely Betancourt: Literature review, data organization, editing, and final revision of the manuscript.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this article.

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