

Implementation of Artificial Intelligence–Based Chatbots for Virtual Academic Tutoring in Higher Education: A Case Study

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Abstract—This study analyzes the implementation of AI-powered conversational solutions, based on structured workflows, as a strategy for virtual academic tutoring in Salvadoran higher education. A mixed-methods approach was adopted through a case study conducted in the Financial Mathematics course at the Universidad Tecnológica de El Salvador. Using the Landbot platform, conversational chatbots with structured dialog flows were designed to provide automated academic support, activity organization, and continuous asynchronous student guidance. The results reveal a highly positive student perception of usability, functional usefulness, and pedagogical support, highlighting improvements in learner autonomy and academic time management. However, limitations related to personalization of the response and the reliance on internet connectivity were also identified. The study is part of a validation phase in a controlled environment (Technology Readiness Level – TRL 4), focusing on student perception as an initial indicator of the system’s effectiveness. The study concludes that AI-driven chatbot-based tutoring represents an innovative and scalable solution with strong potential to improve academic support processes in virtual and asynchronous higher education environments.

Index Terms—artificial intelligence, chatbots, virtual tutoring, higher education, educational innovation.

I. INTRODUCTION

Higher education is undergoing an accelerated transformation driven by digitalization and the integration of artificial intelligence into teaching and learning environments. In particular, virtual and asynchronous education models have increased the demand for academic support strategies that are accessible, timely, and scalable [1]. However, in many Latin American university contexts, academic tutoring still relies primarily on direct instructor intervention, which limits personalized attention and the continuity of student support.

In this context, artificial intelligence–based chatbots have emerged as a technological alternative capable of automating academic guidance processes, answering frequently asked questions, and supporting learning organization through natural language interactions. Previous studies indicate that such tools enhance learner autonomy, time management, and perceived pedagogical support in virtual learning environments [2], [3].

Despite their potential, the implementation of chatbots as academic tutors in Salvadoran and Central American higher education remains limited. Commonly used institutional plat-

forms do not natively integrate automated tutoring mechanisms, creating a gap between students’ support needs and available technological capabilities. This gap highlights the need to explore AI-based solutions that complement traditional academic tutoring.

In response, this study aims to analyze student perceptions of implementing artificial intelligence–based chatbots as a virtual academic tutoring resource in higher education. Through a case study conducted in the Financial Mathematics course at the Universidad Tecnológica de El Salvador, the research evaluates the impact of chatbots on learner autonomy, academic organization, and learning satisfaction, providing empirical evidence to support scalable technopedagogical strategies in virtual university contexts.

II. RELATED WORK

The use of artificial intelligence–based chatbots in education has gained increasing attention as institutions seek scalable solutions to support student learning in virtual and blended environments. Prior research highlights the potential of chatbots to provide immediate feedback, automate administrative and academic support tasks, and enhance student engagement through natural language interaction [4], [5]. These systems have been applied primarily as virtual assistants for answering frequently asked questions, supporting course navigation, and offering basic conceptual explanations.

Several studies report positive effects of chatbot-assisted tutoring on learner autonomy, motivation, and time management in higher education contexts. Rohid et al. [6] and ElSayad et al. [7] emphasize that automated tutoring tools can complement traditional instructional practices by reducing response times and increasing the availability of academic support. Similarly, systematic reviews indicate that chatbots are particularly effective in asynchronous learning environments, where continuous instructor presence is limited [8], [9].

In Latin America, research on educational chatbots remains relatively limited and is often focused on pilot implementations or conceptual analyses. Studies such as Bautista et al. [5] and Peralta et al. [10] identify infrastructural, institutional, and pedagogical challenges that hinder large-scale adoption of AI-driven educational technologies. Moreover, many reported

implementations rely on single-purpose chatbots, offering restricted functionality and limited integration with course-level academic tutoring processes.

In contrast to prior work, this study presents the design and deployment of multiple AI-based chatbots with differentiated academic roles within a real undergraduate course. By evaluating student perceptions through a mixed-methods approach, the present work contributes empirical evidence from a Central American higher education context and proposes a practical, replicable model for virtual academic tutoring that extends beyond isolated chatbot applications.

III. METHODOLOGY

This study adopted a mixed-methods research design, integrating quantitative and qualitative approaches to obtain a comprehensive understanding of students' perceptions regarding the use of artificial intelligence-based chatbots for virtual academic tutoring. The mixed-methods approach was selected due to its suitability for exploring both measurable trends and subjective user experiences in educational technology research. The study was conducted as a descriptive and exploratory case study, following the methodological guidelines proposed by Yin [11]. This approach is particularly relevant for exploratory studies in educational settings, as it allows for the combination of the analysis of measurable perceptions with the interpretation of subjective experiences. From a technological maturity perspective, this study can be classified as being at the controlled environment validation stage (Technology Readiness Level – TRL 4), where the primary objective is to evaluate the functionality, acceptance, and pedagogical viability of the solution before scaling it up to broader contexts.

A. Research Context and Participants

The study was carried out during the 2025-II academic term in the Financial Mathematics course at the Universidad Tecnológica de El Salvador. The participants consisted of 36 undergraduate students enrolled in virtual learning modality programs related to business and engineering fields. A non-probabilistic, intentional sampling strategy was employed, as all participants interacted with the implemented chatbots as part of the academic support activities.

B. Chatbot Design and Implementation

The chatbot system was developed using the Landbot platform [12] and implemented through structured conversational flows, combining predefined response options, automated messages, and decision-based navigation. The design process followed an iterative prototyping approach, allowing refinement of dialog structures and academic content prior to full deployment. It is important to note that these systems are based on conversational automation guided by structured workflows, which represents a basic level of applied artificial intelligence.

Four chatbots with differentiated academic functions were implemented: (1) a pilot chatbot designed to introduce basic financial concepts and validate interaction flows (Fig. 1); (2) a

chatbot focused on assessment dates and academic reminders to support time management (Fig. 2); (3) a chatbot dedicated to academic events and student presentations; and (4) a primary Financial Mathematics virtual assistant providing conceptual support, automated reminders and access to learning materials (Fig. 3). All chatbots were deployed in an asynchronous virtual environment and remained accessible throughout the academic term.

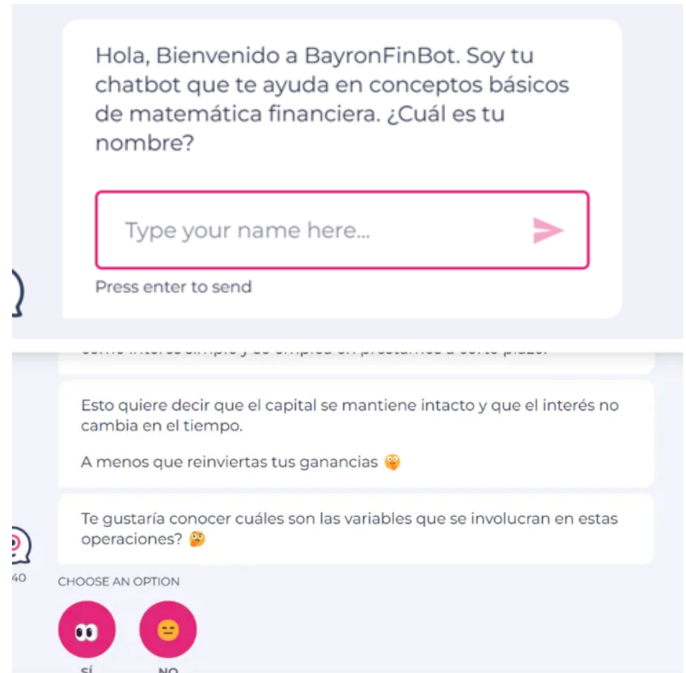


Fig. 1: Pilot chatbot: greeting interface and interaction flow.

C. Data Collection Instruments

Data were collected using an online structured questionnaire composed of 15 items on the Likert-scale (1–5), designed to measure usability, perceived usefulness, accessibility, and frequency of use. In addition, open-ended questions were included to capture qualitative feedback related to perceived benefits, limitations, and improvement suggestions. The instrument design was in line with previous studies on educational chatbot evaluation [13], [14].

D. Procedure

The methodological procedure was conducted in four sequential phases: planning, chatbot design, implementation, and evaluation. During the implementation phase, students interacted freely with the chatbots over a four-week period within the virtual learning environment. Upon completion of the intervention, the questionnaire was administered using Microsoft Forms to collect perception data.

E. Data Analysis

Quantitative data were analyzed using descriptive statistics, including frequencies and percentages, to identify general

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Fig. 2: Assessment dates chatbot: interface and automated responses.

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Microsoft Teams

Canal de Youtube

LinkedIn

Fig. 3: Financial Mathematics virtual assistant: menu and interaction flow.

trends in student perceptions [15]. Qualitative data were analyzed using thematic analysis, following the approach proposed by Braun and Clarke [16], which allowed the identification of recurring themes related to benefits, limitations, and user experience. The integration of quantitative and qualitative findings enabled data triangulation and enhanced the validity of the results. This analysis made it possible to supplement the quantitative results by interpreting the participants' experiences and subjective assessments.

IV. RESULTS

Data collection was conducted during the 2025-II academic term in the Financial Mathematics course at the Universidad Tecnológica de El Salvador. A total of 36 undergraduate students participated in the study and completed the perception questionnaire after interacting with the implemented chatbots over a four-week period.

A. Overall Perception of Chatbot Use

Overall results indicate a high level of acceptance of AI-based chatbots as academic support tools. As summarized in Table I, 61% of participants rated the chatbot system as very easy to use, while 69% perceived it as very useful for academic activities. Additionally, 97% of students reported that chatbot use contributed positively to their learning process and expressed willingness to recommend its use in other courses. Figure 4 presents a visual summary of students' perceptions regarding ease of use, clarity of instructions, and perceived usefulness, showing a predominance of positive evaluations across all measured dimensions.

TABLE I: Descriptive results of student perception regarding chatbot use

Dimension	Category	n	%
Ease of use	Very easy	22	61
Clarity of instructions	Very easy	22	61
Perceived usefulness	Very useful	25	69
Contribution to learning	Yes	35	97
Recommendation of use	Yes	35	97

B. Contribution to Autonomy and Time Management

Regarding learning autonomy and time management, 85% of students indicated that chatbot interaction supported better organization of academic tasks and planning of activities. Figure 5 illustrates the perceived contribution of chatbots to learning and students' intention to recommend their use in other subjects.

C. Comparison of Implemented Chatbots

A comparative analysis of the implemented chatbots is presented in Table II. The Financial Mathematics virtual assistant was identified as the most valued chatbot by 55% of participants, followed by the assessment dates chatbot. Figure 6 complements these findings by comparing perceived ease of use and clarity among the different chatbots.

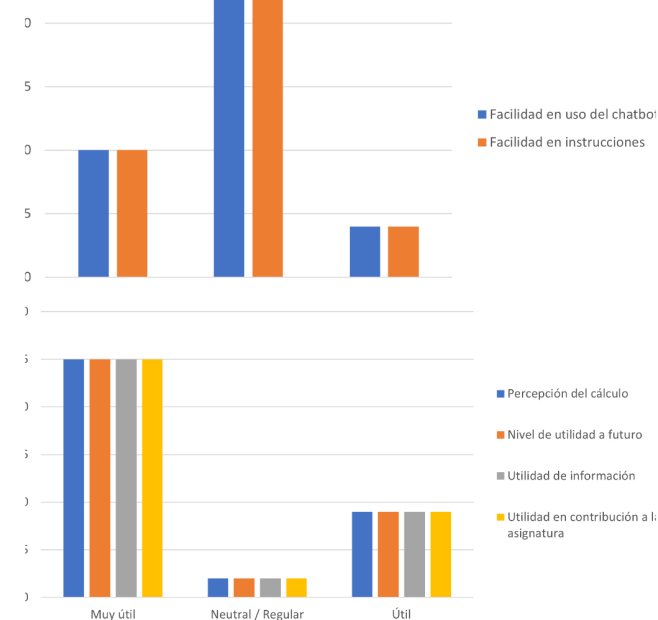


Fig. 4: Perceived ease of use, clarity of instructions, and usefulness of the chatbot system.

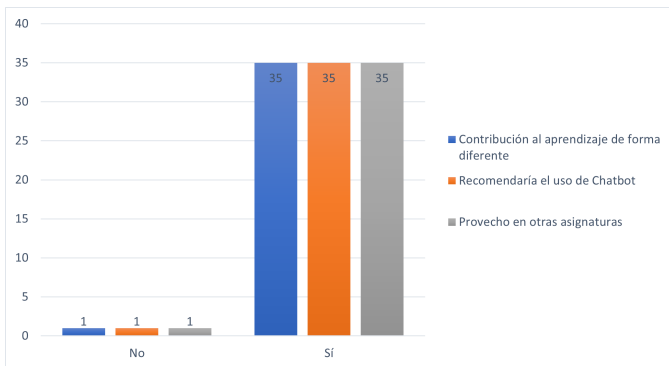


Fig. 5: Perceived contribution of chatbots to learning and recommendation for use in other courses.

TABLE II: Comparative evaluation of implemented chatbots

Category	Key Indicator	%
Most valued chatbot	Financial Mathematics Assistant	55
Ease of use	Very easy	83
Academic support usefulness	Very useful	70
Most valued aspect	Ease of use	37
Main suggestion	Expanded functionality	35
Overall opinion	Positive	82

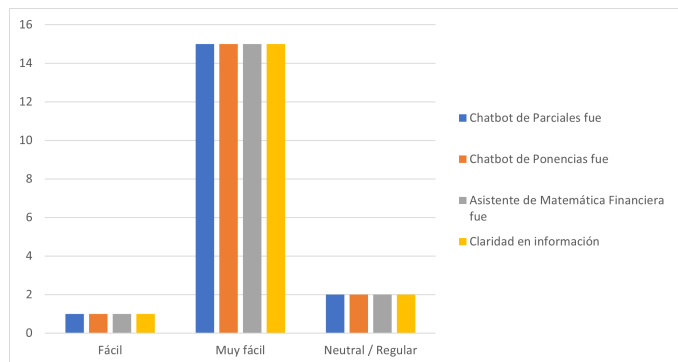


Fig. 6: Comparison of perceived ease of use and clarity among implemented chatbots.

D. Qualitative Feedback and Identified Limitations

Qualitative responses provided additional insight into user experience. As shown in Figure 7, the strengths mentioned most frequently were ease of use (37%), response speed (25%) and clarity of information (19%). Identified limitations and suggestions for improvement are summarized in Figure 8, highlighting requests for expanded functionality, increased personalization, and improved platform integration.

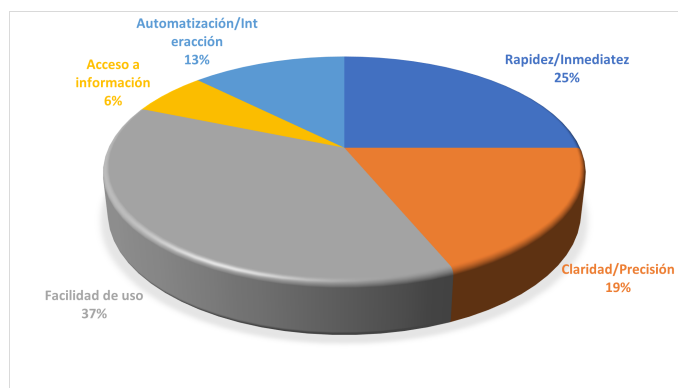


Fig. 7: Most valued aspects of chatbot use reported by students.

V. DISCUSSION

The findings of this study confirm the growing relevance of artificial intelligence-based chatbots as effective support tools in virtual higher education environments. Consistent with prior research, the results show high levels of student acceptance regarding usability and perceived usefulness, reinforcing the role of conversational agents in facilitating access to academic support and information [17], [18].

In line with previous studies highlighting the impact of automated tutoring on learner autonomy and time management [19], [20], participants in this study reported significant improvements in academic organization and self-regulation. These outcomes are particularly relevant in asynchronous learning contexts, where continuous instructor presence is

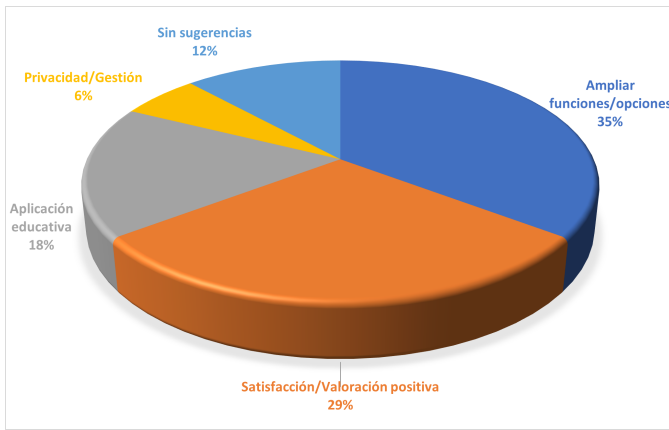


Fig. 8: Student perceptions and suggestions for improvement.

limited and students must rely on digital resources for timely guidance.

Compared to earlier implementations reported in the literature, which often focus on single-purpose or pilot chatbots [21], [22], this study demonstrates the value of deploying multiple chatbots with differentiated academic roles within a single course. The higher valuation of the Financial Mathematics virtual assistant suggests that chatbots providing direct curricular support generate greater perceived impact than those limited to administrative functions, supporting findings reported by Morales-García [23]. In this regard, the findings suggest that these tools not only facilitate access to information but also promote active learning processes through ongoing interaction in digital environments.

From a regional perspective, the results contribute empirical evidence from a Central American higher education context, addressing a gap identified in Latin American studies on educational chatbots [24], [25]. The positive perceptions observed indicate that AI-based tutoring solutions can be successfully adopted even in contexts with limited prior experience in educational artificial intelligence, provided that the tools are intuitive and aligned with course-level needs.

From a technological perspective, it is important to note that the chatbots implemented in this study are based on structured conversational flows, which corresponds to a guided automation approach rather than adaptive or generative artificial intelligence systems. However, the results show that even this type of solution can have a significant pedagogical impact in real educational contexts, especially when aligned with specific curriculum objectives.

The results should be interpreted within the framework of an initial phase of technological validation. From the perspective of Technology Readiness Levels (TRL), this study falls under the controlled environment validation level (TRL 4), where the primary purpose is to evaluate the functionality, acceptance, and relevance of the solution prior to its scaling. In this regard, the characteristics of the methodological design—such as sample size and the use of descriptive statistics—reflect the exploratory nature of this stage and allow for the collection of

preliminary evidence relevant to future implementations.

Despite these positive outcomes, certain limitations must be acknowledged. The dependence on stable internet connectivity and the limited emotional personalization of chatbot responses were recurrent concerns among participants. These challenges are consistent with those reported in prior studies and highlight the importance of institutional infrastructure and the potential integration of affective computing techniques in future chatbot designs [26].

Overall, the discussion of results suggests that AI-driven chatbots represent a viable and scalable complement to traditional academic tutoring. Their implementation supports not only administrative efficiency but also pedagogical processes related to autonomy, organization, and continuous academic support, reinforcing their potential role within engineering and technology-oriented higher education programs.

VI. CONCLUSIONS

This study analyzed the implementation of artificial intelligence-based chatbots as a virtual academic tutoring strategy in higher education through a mixed-methods case study conducted in a Financial Mathematics course. The findings indicate that chatbot-based tutoring was positively perceived by the students, particularly in terms of usability, perceived usefulness, and continuous academic support in asynchronous learning environments.

The results show that the use of multiple chatbots with differentiated academic roles contributed to improvements in learner autonomy, academic organization, and time management. Among the implemented tools, the chatbot providing direct curricular support was identified as the most valuable, suggesting that AI-driven tutoring systems aligned with course content generate greater pedagogical impact than chatbots limited to administrative functions.

From an engineering education perspective, this work contributes empirical evidence of a practical and scalable model for virtual academic tutoring supported by conversational artificial intelligence. The study demonstrates that chatbot-based solutions can effectively complement traditional academic tutoring and support digital transformation initiatives in higher education institutions, particularly in Latin American contexts.

VII. LIMITATIONS AND FUTURE WORK

Despite the positive outcomes, several limitations must be acknowledged. First, the study was conducted as a single-case implementation with a relatively small sample size, which limits the generalizability of the findings. Second, the evaluation focused on student perceptions rather than objective indicators of academic performance. Additionally, the chatbot system relied on predefined conversational flows, which constrained the level of emotional personalization and adaptive feedback.

However, the results should be interpreted with caution, given that the study was conducted using a small, non-probabilistic sample within a specific context. These characteristics are consistent with a validation phase in a controlled environment (Technology Readiness Level – TRL 4), which

limits the generalizability of the findings to other educational contexts.

Furthermore, this study focused on analyzing student perceptions without incorporating objective indicators of academic performance, such as grades, completion rates, or retention metrics; therefore, it is recommended that future studies incorporate learning analytics to more accurately assess the impact of chatbots on effective learning.

Future research should explore longitudinal studies involving multiple courses and institutions to assess the impact of AI-based tutoring on academic performance, retention, and learning outcomes. Further work may also focus on integrating affective computing, natural language understanding, and learning analytics to enhance personalization and emotional responsiveness. Finally, deeper integration with institutional learning management systems could strengthen the scalability and effectiveness of chatbot-based academic support solutions.

REFERENCES

- [1] M. S. Ramírez-Montoya, R. McGreal, and J.-F. O. Agbu, "Horizontes digitales complejos en el futuro de la educación 4.0: luces desde las recomendaciones de unesco," *RIED. Revista Iberoamericana de Educación a Distancia*, vol. 25, no. 2, pp. 09–21, 2022.
- [2] M. A. Kuhail, N. Alturki, S. Alramlawi, and K. Alhejori, "Interacting with educational chatbots: A systematic review," *Education and Information Technologies*, vol. 28, no. 1, pp. 973–1018, 2023.
- [3] G. S. Lescano López, A. M. Boy Barreto, S. L. Romero Vela, J. Godoy Caso, and C. Quinto Huamán, "E-learning in the teaching-learning of distance higher education: A review," *LACCEI*, vol. 1, no. 8, 2023.
- [4] E. M. R. Chávez, J. M. P. Sánchez, B. G. Bravo, and J. L. S. Toscano, "Integración de la inteligencia artificial en estrategias de aprendizaje en educación superior: una revisión sistemática," *Revista Tribunal*, vol. 6, no. 14, pp. 298–320, 2026.
- [5] M. Fernández-Miranda, D. Román-Acosta, A. A. Jurado-Rosas, D. Limón-Domínguez, and C. Torres-Fernández, "Artificial intelligence in latin american universities: Emerging challenges," *Computación y Sistemas*, vol. 28, no. 2, pp. 435–450, 2024.
- [6] N. Rohid, S. Masitoh, and F. Arianto, "Effectiveness of using educational chatbots in improving student learning independence," *Perinatal Journal*, vol. 33, no. 1, pp. 510–519, 2025.
- [7] G. ElSayad and H. A. Mamdouh, "Ai-driven learning: evaluating the role of chatbots in enhancing student motivation and learning outcomes," *Journal of Applied Research in Higher Education*, pp. 1–13, 2025.
- [8] A. N. Ansari, "Systematic review on ai chatbots as a provision for self-paced learning," *Ethical, Legal, and Pedagogical Perspectives on AI in Education*, pp. 123–144, 2026.
- [9] O. C. Adiguzel, P. Potvin, and E. Esen, "The impact of neuroscience and artificial intelligence on feedback: a systematic review," *Educational technology research and development*, pp. 1–42, 2026.
- [10] W. O. G. Peralta, "Implementación de chatbots educativos con ia para el aprendizaje autónomo en estudiantes universitarios," *Innovarium International Journal*, vol. 3, no. 2, pp. 1–12, 2025.
- [11] H. Lehmann, "Research method: Grounded theory for descriptive and exploratory case studies," in *The Dynamics of International Information Systems: Anatomy of a Grounded Theory Investigation*. Springer, 2010, pp. 53–65.
- [12] S. HELLO UMI, "Ai agent & chatbot builder for whatsapp + website — landbot," 2025. [Online]. Available: <https://landbot.io/>
- [13] C. R. Palacios, E. L. Palacios, F. D. Álvarez, and D. A. Lizarzaburu, "Validación de un cuestionario de actitud de estudiantes universitarios hacia el uso de chatbots de inteligencia artificial generativa," *Formación universitaria*, vol. 18, no. 5, pp. 15–32, 2025.
- [14] B. H. Espinosa-Luna, J. Castillo-Oliva, B. A. Montañez-Díaz, and A. Mendoza-De-los Santos, "Implementación de un chatbot basado en modelo de lenguaje de inteligencia artificial para responder preguntas frecuentes de estudiantes universitarios," *Revista Científica de Sistemas e Informática*, vol. 3, no. 2, pp. e570–e570, 2023.
- [15] C. A. V. González, "Importancia de la estadística aplicada a la educación," *Revista Científica de la Facultad de Filosofía*, vol. 20, no. 2, 2024.
- [16] V. Braun, V. Clarke *et al.*, "Thematic analysis: A practical guide," 2022.
- [17] C. K. Nee, M. H. A. Rahman, N. Yahaya, N. H. Ibrahim, R. A. Razak, and C. Sugino, "Exploring the trend and potential distribution of chatbot in education: A systematic review," *International Journal of Information and Education Technology*, vol. 13, no. 3, pp. 516–525, 2023.
- [18] H. G. Aguilar, "Some trends on artificial intelligence in legal education," in *Proceedings of the 22nd LACCEI International Multi-Conference for Engineering, Education and Technology: Sustainable Engineering for a Diverse, Equitable, and Inclusive Future at the Service of Education, Research, and Industry for a Society 5.0., LACCEI 2024*. Latin American and Caribbean Consortium of Engineering Institutions, 2024.
- [19] B. G. Acosta Enriquez, L. I. Villena Zapata, E. V. Ramos Farroñan, F. S. Mogollon Garcia, S. E. Pagador Flores, J. Alva Morales, and M. A. Sevilla Angelaths, "Teacher training and autonomous learning in students of semester 2022-ii," *LACCEI*, vol. 1, no. 8, 2023.
- [20] M. E. Meneses-La-Riva, H. G. Ocupa-Cabrera, J. A. Suyu-Vega, V. H. Fernández-Bedoya, G. D. D. Ocupa-Meneses, B. D. D. Ocupa-Meneses, and S. A. Alvarado-Suyo, "Use of the online platform and its relationship with academic stress in jaen high school students (cajamarca, peru)," *LACCEI*, vol. 1, no. 8, 2023.
- [21] J. T. Galea, D. H. Vasquez, N. Rupani, M. B. Gordon, M. Tapia, K. Y. Greene, L. Kolevic, M. F. Franke, and C. Contreras, "Development and pilot-testing of an optimized conversational agent or "chatbot" for peruvian adolescents living with hiv to facilitate mental health screening, education, self-help, and linkage to care: protocol for a mixed methods, community-engaged study," *JMIR Research Protocols*, vol. 13, no. 1, p. e55559, 2024.
- [22] I. Huet, D. Casanova, T. Hoque, and P. Isaías, "The design and implementation of a pilot chatbot in distance education," *Challenges 2024: Espaços e Caminhos OnLife*, 2024.
- [23] W. C. Morales-García, L. Z. Sairitupa-Sanchez, S. B. Morales-García, and M. Morales-García, "Development and validation of a scale for dependence on artificial intelligence in university students," in *Frontiers in Education*, vol. 9. Frontiers Media SA, 2024, p. 1323898.
- [24] L. Priscila Wunsch, J. Rafael Nikolay, and E. D. Silva de Freitas, "Chatbot: digital communication and religion after the pandemic in latin america," *Universitas, Revista de Ciencias Sociales y Humanas*, no. 37, 2022.
- [25] D. Ramírez Plascencia and R. M. Alonzo González, "The rise of artificial intelligence in latin america," in *Ethical and Legal Dilemmas of Artificial Intelligence in Latin America*. Springer, 2025, pp. 1–18.
- [26] G. Bilquise, S. Ibrahim, and K. Shaalan, "Emotionally intelligent chatbots: A systematic literature review," *Human Behavior and Emerging Technologies*, vol. 2022, no. 1, p. 9601630, 2022.