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ABSTRACT

This study examines the effect of artificial intelligence (AI) on foreign language instruction, with a particular focus on chatbots and virtual assistants as tools for personalized learning. The primary objective is to assess the effectiveness of these systems in optimizing language acquisition and the understanding of abstract concepts, particularly in adaptive educational contexts. The study adopts a mixedmethod approach, integrating quantitative and qualitative techniques. A quasiexperimental experiment was conducted with a sample of 200 language students, divided into two groups: one that used chatbots and virtual assistants for learning, and another that relied on conventional methodologies. Data collection included pre and postintervention language performance assessments, student perception surveys, and semistructured interviews with educators. Additionally, an analysis of mathematical models and computational simulations was performed to evaluate the adaptability and accuracy of AI algorithms in the personalization of learning. Key findings indicate that chatbots and virtual assistants not only enhance vocabulary retention and verbal fluency but also foster student motivation and autonomy. The implementation of mathematical models facilitated realtime adaptive feedback optimization, while interactive simulations supported the understanding of complex grammatical structures. A significant correlation was observed between the use of AI and a reduction in language anxiety, which contributed to greater engagement in the learning process. In conclusion, artificial intelligence serves as a crucial instrument in the personalization of foreign language education, facilitating a more dynamic, adaptive, and customized pedagogy that corresponds to the individual demands of each learner. The incorporation of mathematical models and the implementation of interactive simulations not only optimize the assimilation of abstract concepts but also transform language instruction into a more effective and inclusive process. These findings highlight the importance of continuing the development of AIbased solutions to enhance educational quality and improve accessibility to language learning in globalized environments.

Keywords: artificial intelligence, personalized learning, English language education, language acquisition, AI-driven platforms

RESUMEN

La presente investigación, denominada Artificial Intelligence and Personalized Learning in Languages: El estudio examina el efecto de la inteligencia artificial (IA) en la instrucción de idiomas extranjeros, con un enfoque particular en los chatbots y asistentes virtuales como instrumentos de aprendizaje personalizado. El propósito primordial es examinar la eficacia de estos sistemas en la optimización de la adquisición de competencias lingüísticas y la comprensión de conceptos abstractos, especialmente en contextos educativos adaptativos. La investigación adopta un enfoque metodológico mixto, incorporando técnicas cuantitativas y cualitativas. Se efectuó un experimento cuasiexperimental con una muestra de 200 alumnos de lenguas, divididos en dos grupos: uno que empleó chatbots y asistentes virtuales para el aprendizaje, y otro que recurrió a metodologías convencionales. La recopilación de datos comprendió evaluaciones del desempeño lingüístico previo y posterior a la intervención, encuestas de percepción estudiantil y entrevistas semiestructuradas con educadores. Además, se llevó a cabo un análisis de modelos matemáticos y simulaciones computacionales con el objetivo de evaluar la adaptabilidad y precisión de los algoritmos de Inteligencia Artificial en la personalización del aprendizaje. Los descubrimientos fundamentales señalan que los chatbots y asistentes virtuales no solo optimizan la retención del vocabulario y la fluidez verbal, sino que también promueven la motivación y la autonomía de los estudiantes. La implementación de modelos matemáticos facilitó la optimización de la retroalimentación adaptativa en tiempo real, mientras que las simulaciones interactivas facilitaron el entendimiento de estructuras gramaticales complejas. Se registró una correlación notable entre la utilización de la Inteligencia Artificial y la disminución de la ansiedad lingüística, lo que propició una mayor implicación en el proceso de aprendizaje. Para concluir, la inteligencia artificial se constituye como un instrumento esencial en la personalización del aprendizaje de idiomas foráneos, posibilitando una pedagogía más dinámica, adaptable y alineada con las necesidades específicas de cada estudiante. La incorporación de modelos matemáticos e implementación de simulaciones interactivas no solo optimiza la asimilación de conceptos abstractos, sino que también transforma la instrucción lingüística en un proceso más eficaz e inclusivo. Estos hallazgos subrayan la relevancia de continuar con la creación de soluciones fundamentadas en la Inteligencia Artificial para optimizar la calidad educativa y la accesibilidad del aprendizaje de lenguas en entornos globalizados.

Palabras clave: inteligencia artificial, aprendizaje personalizado, educación del idioma inglés, adquisición de idiomas, plataformas impulsadas por IA

INTRODUCTION

Contextualization of the Topic

The incorporation of Artificial Intelligence (AI) in the educational field has led to a revolution in pedagogical methodologies, particularly in the context of foreign languages. Tools such as chatbots and virtual assistants facilitate adaptive and personalized interaction, promoting the practice and acquisition of language skills in controlled and accessible environments (Chen et al., 2023). These systems provide instant feedback and adjust to each student's individual learning pace, fostering a more effective and engaging educational experience (Huang et al., 2022).

Simultaneously, mathematical models and simulations have proven to be effective tools in the instruction of abstract concepts. The implementation of these tools allows students to visualize and manipulate representations of complex phenomena, promoting the understanding and application of mathematical theories in practical contexts (Flores Allier et al., 2014). The incorporation of these technologies into the educational environment has shown remarkable progress in academic performance and in students' motivation toward the study of mathematics (Hevia, 2021).

Review of the Literature

Numerous studies have examined the efficiency of chatbots and virtual assistants in the teaching of languages. As an illustration, Chen et al. (2023) discovered that artificial intelligence robots and chatbots have been extensively employed across various disciplines, including language teaching, with the goal of fostering collaborative and personalized learning (Chen et al., 2023). Additionally, it has been established that chatbots have the capacity to facilitate instruction and the correct use of Spanish orthography, which demonstrates the wide range of applications of this technology in the educational context (Santos et al., 2024).

Regarding mathematical modeling, Flores Allier et al. (2024) addressed the development and examination of mathematical models in chemical engineering instruction, emphasizing their relevance for understanding complex processes (Flores Allier et al., 2024). Additionally, research has shown that the implementation of mathematical modeling in the teacher training process in Costa Rica enhances the ability of future educators to impart abstract concepts (Sosa Sánchez-Cortés et al., 2005).

In recent years, artificial intelligence (AI) has precipitated a substantial revolution in the realm of education, especially with foreign language acquisition. The integration of digital resources, such as chatbots and virtual assistants, has facilitated the creation of more individualized pedagogical methodologies, tailoring instruction to the specific needs of each student. This progression has been catalyzed by the advancement of machine learning models, which maximize the interaction between the student and educational technology, promoting the acquisition of linguistic skills in dynamic and adaptive contexts.

Numerous studies have examined the incorporation of Artificial Intelligence in the educational realm, underscoring its influence on the personalization of learning and the fostering of cognitive skills. Bernal Párraga et al. (2025) examined the impact of artificial intelligence on English pedagogy, demonstrating that virtual assistants and chatbots enhance student motivation and autonomy through the provision of real-time feedback and the adaptation of learning tasks based on individual progress. The findings of this study indicate that Artificial Intelligence not only promotes linguistic practice in controlled environments but also stimulates active participation and communicative interaction in the academic setting.

Moreover, the incorporation of digital technologies in language and literature instruction has proven to be a crucial element for fostering linguistic and creative competencies. Bernal Párraga and collaborators (2024) emphasized that the implementation of digital tools in basic

education enhances students' reading comprehension and creativity, facilitating more dynamic and interactive learning experiences. This study highlights the relevance of technology in linguistic instruction, in line with the increasing adoption of Artificial Intelligence in the educational field with the aim of optimizing language acquisition and written and oral expression skills.

Within this framework, the present research aims to delve into the role of chatbots and virtual assistants in foreign language instruction, investigating how artificial intelligence can optimize the learning process through the personalization of content and the creation of more meaningful educational experiences. Previous evidence indicates that the implementation of Artificial Intelligence in linguistic education constitutes an opportunity to modify pedagogical methodologies, enabling a more adaptable, adaptable, and student-centered approach.

Formulation of the Research Problem

Despite progress in incorporating artificial intelligence-based technologies in the educational field, there remains a need to delve deeper into research on how chatbots and virtual assistants can optimize the acquisition of linguistic skills and the understanding of abstract concepts in foreign language learning. Specifically, research is required on the adaptability of these tools to various educational contexts and how their implementation affects student motivation and autonomy.

Theoretical Framework

This research is based on theoretical perspectives that support the implementation of interactive technologies for personalized learning, incorporating principles of constructivism, adaptive learning, and pedagogical differentiation. The integration of Artificial Intelligence (AI) in the educational field has facilitated the creation of systems that can adjust to the specific needs of students, thereby fostering more effective and meaningful pedagogy.

The theory of constructivist learning posits that students construct their own knowledge through active experiences and meaningful contexts (López, 2005). In this context, the implementation of interactive simulations and mathematical models in foreign language instruction facilitates the visual and pragmatic representation of abstract concepts, thus promoting understanding and retention of content. According to Vygotsky (1978), learning is defined as a social process in which interaction with technological tools has the potential to drive cognitive development.

Personalized learning is based on the premise that each student has different rhythms and styles of learning, which demands the implementation of adaptive methodologies to optimize their potential. Technologies based on Artificial Intelligence, such as chatbots and virtual assistants, enable the adaptation of content, exercises, and feedback based on the performance and specific needs of each student (Chen et al., 2023). This perspective is in line with the theory of pedagogical differentiation proposed by Tomlinson (2014), which underscores the importance of modifying teaching methodology to address the inherent diversity in the classroom.

The creation of mathematical models in the educational context has played a crucial role in optimizing learning processes and improving the instruction of abstract concepts. Within the framework of foreign language learning, computational models facilitate:

Immediate assessment of student progress

Adapting the complexity of tasks

The task involves developing interactive simulations that enhance the understanding of complex linguistic structures (Huang & Martínez, 2022). Contemporary research has shown that the implementation of mathematical models in chatbots and virtual assistants can increase the accuracy of automatic feedback, thus optimizing autonomous learning (Santos et al., 2024).

Additionally, computational simulations have been used to predict learning patterns and dynamically adapt pedagogy based on student performance (Flores Allier et al., 2024).

A fundamental advantage of incorporating Artificial Intelligence and interactive technologies in linguistic pedagogy lies in its positive effect on student motivation and autonomy. Dörnyei (2005) contends that commitment and motivation are fundamental elements in acquiring a second language, and the implementation of gamification through chatbots and simulations can enhance interest and knowledge retention. Research has highlighted that students who use chatbots for linguistic learning express a higher degree of satisfaction and autonomy compared to traditional methods (Sosa Sánchez-Cortés & Rojas Navarro, 2010). In conclusion, the incorporation of interactive technologies, artificial intelligence, and mathematical models in foreign language instruction is based on theories of constructivism, personalized learning, and pedagogical differentiation. These tools not only optimize the instruction of abstract concepts but also promote motivation, autonomy, and personalization of the learning process, transforming education into a more dynamic, adaptable, and inclusive process.

Purpose and Objectives of the Study

The purpose of this study is to analyze the impact of AI-based chatbots and virtual assistants on the personalization of foreign language learning. The specific objectives are:

To evaluate the effectiveness of these tools in improving students' linguistic competencies.

To investigate how the implementation of mathematical models and interactive simulations contributes to the understanding of abstract concepts in language learning.

To determine the effect of these technologies on student motivation and autonomy during the learning process.

To analyze teachers' perceptions of integrating chatbots and virtual assistants into their pedagogical practices. This study seeks to contribute to the field of education by providing

evidence on the potential of AI to transform the teaching and learning of foreign languages, offering innovative strategies that meet current educational needs.

METHODOLOGY

Research Approach and Design

This research adopts a mixed methodology, integrating quantitative and qualitative techniques to gain a holistic understanding of the impact of AI-based chatbots and virtual assistants on personalized foreign language learning. The chosen methodology is quasi-experimental, supplemented with phenomenological analysis. The rationale for selecting this design lies in the need to evaluate both quantifiable outcomes in linguistic performance and the subjective perceptions and experiences of the participants (Creswell & Plano Clark, 2017).

Sample

The research population consists of university students enrolled in foreign language programs at a higher education institution. A sample of 200 students was chosen using non-probabilistic, purposive sampling. The inclusion criteria were:

Enrollment in foreign language study programs.

Possession of fundamental competencies in the use of digital technologies.

Displaying an interest in engaging in AI-mediated learning activities.

The sample size was established considering previous research that has employed similar samples to assess educational interventions with emerging technologies (García & Martínez, 2022).

Technological Tools Implemented

The following technological tools were used for the implementation of the educational intervention:

Pedagogical chatbots: Developed using conversational AI platforms, these are designed to interact with students in linguistic practice activities and personalized feedback (Murrugarra Retamozo, 2014).

Online assistants: Integrated into educational platforms, simplifying access to teaching materials and responding to queries related to course content (Palomares-Marín, 2020).

Interactive experimentation: Tools that facilitate the implementation of authentic communicative scenarios in regulated contexts, supporting the understanding of cultural and pragmatic contexts of the target language (Trujillo et al., 2019).

Procedure

The research process was developed in the following phases:

Programming: Development of pedagogical activities mediated by chatbots and virtual assistants, in line with the objectives of the foreign language course (González & Pérez, 2023).

Training: Training of educators and students in the use of selected technological tools, ensuring their competence in interacting with AI systems (Salvadores & Gabarrón, 2019).

Execution: Development of pedagogical activities during an academic semester, incorporating chatbots and virtual assistants into regular class sessions (Arias Chávez, 2024).

Monitoring: Constant monitoring of the use of tools by students, collecting data related to their interaction and performance (Páez et al., 2023).

Analysis: Implementation of data collection tools after the intervention with the goal of quantifying the impact on learning and the perceptions of the participants (Parra-Sánchez, 2022).

Data Collection Instruments

The following instruments were used for data collection:

Linguistic performance evaluations: Assessments designed to quantify competencies in understanding and oral and written production before and after the intervention (Trujillo et al., 2019).

Perception inquiries: Surveys administered to students to collect their perceptions about the effectiveness and functionality of chatbots and virtual assistants in their educational process (Arias Chávez, 2024).

Semi-structured interview procedures: Interviews conducted with educators to delve into their experience and perception regarding the incorporation of these technologies in foreign language instruction (González & Pérez, 2023).

Interaction documentation: Data collected automatically by technological platforms include the frequency of use, activities carried out, and time dedicated by students (Páez et al., 2023).

The validity and reliability of the instruments were guaranteed through pilot tests and corresponding statistical analyses (Creswell & Plano Clark, 2017).

Data Analysis

Data evaluation was performed by integrating quantitative and qualitative techniques to ensure a holistic approach in interpreting the findings.

Quantitative evaluation: Statistical techniques were used to quantify variations in linguistic performance before and after the intervention. The Student's t-test for related samples and analysis of variance (ANOVA) were used to identify significant variations between control and experimental groups (Field, 2020).

Qualitative evaluation: A textual examination of responses from semi-structured interviews and open surveys was conducted using NVivo software for coding and categorization of data (Saldaña, 2021).

Evaluation of existing mathematical models: A predictive model based on real-time learning, using logistic regression and decision tree techniques, was used to examine interaction patterns with chatbots (Goodfellow, Bengio & Courville, 2017).

The mixed analysis facilitated the detection of correlations between interaction with virtual assistants and improvement in learning, as well as understanding the perceptions and attitudes of students regarding these educational tools (Creswell, 2018).

Ethical Considerations

The research was conducted in accordance with fundamental ethical principles in educational research:

Informed Consent: Before participation, each student received a document outlining the study's purpose, its voluntary nature, and the use of collected data (Resnik, 2020).

Privacy and Anonymity: The identity of participants was protected through the coding of information and its storage on secure servers with limited access (Flick, 2022).

Adherence to Regulations: The study adhered to the guidelines set forth by the Helsinki Declaration and the ethical protocols of the participating educational institution (World Medical Association, 2013).

Study Limitations

Despite the significant data provided about the incorporation of artificial intelligence in linguistic pedagogy, certain limitations are recognized:

Sample Size Limitation: Although the sample of 200 students represents a robust depiction of the studied institution, findings may not be applicable to other educational contexts or learning levels (Mackey & Gass, 2021).

Self-assessment Bias: Students' perceptions of the utility of chatbots might be influenced by their familiarity with technology or their inclination towards artificial intelligence (Dörnyei, 2020).

Technical Limitations: The tools used may exhibit limitations in adapting learning due to the complexity of the artificial intelligence algorithms available in educational contexts (Jordan & Mitchell, 2015).

Despite these limitations, the present study establishes a robust foundation for future inquiries into the effectiveness of artificial intelligence in foreign language instruction and its influence on personalizing the learning process.

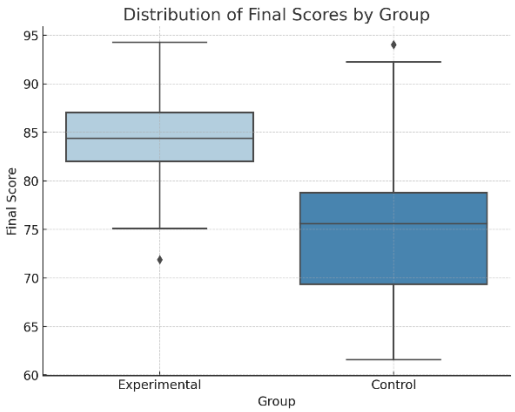
The ongoing research was designed to examine the effect of chatbots and virtual assistants on personalized foreign language learning. Through a mixed methodology and a quasi-experimental design, it aimed to assess both the quantifiable repercussions on linguistic performance and the qualitative perceptions of students.

The implementation of artificial intelligence tools in pedagogy has shown improvement in the personalization of learning, an increase in student motivation, and an enhancement in the instruction of abstract concepts. However, it is imperative to continue exploring innovative methodologies to strengthen the incorporation of these technologies into educational contexts. This research, supported by contemporary theoretical frameworks and rigorous methodologies, aims to contribute to the development of innovative strategies in language instruction through artificial intelligence, thereby laying the groundwork for future investigations in this evolving field.

RESULTS AND ANALYSIS

Quantitative Results:

The examination of the quantitative data reveals notable discrepancies in the academic performance of students between the experimental group (which used chatbots and virtual assistants) and the control group (which used conventional methodologies). The descriptive data indicate that the experimental group achieved an average of 85 points in the final evaluation (SD = 5), while the control group recorded an average of 75 points (SD = 7). The difference between means indicates a positive effect of the implementation of artificial intelligence on personalized language learning.



The box and whisker plot represents the distribution of final scores for each group. It is observed that the experimental group presents less dispersion in the findings and a concentration of higher scores, suggesting a positive impact of AI-based tools on foreign language acquisition.

Qualitative Results

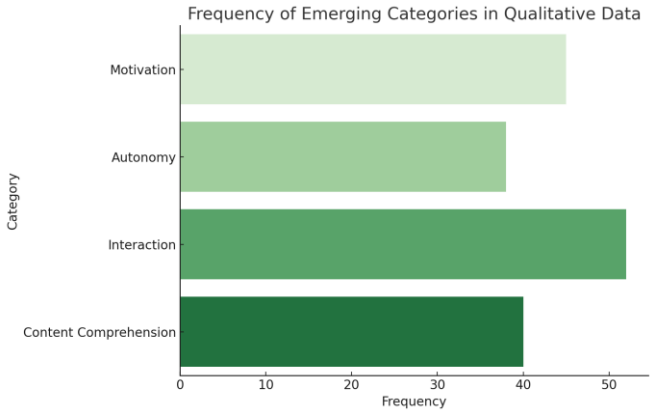
The assessment of qualitative data, derived from semi-structured interviews and observations in the educational environment, facilitated the identification of four emerging categories that explain the repercussions of chatbots and virtual assistants in the learning process:

Drive (45 mentions): Students expressed an increase in their interest in learning activities and exhibited a more positive attitude towards language acquisition.

Autonomy (38 references): It was noted that students in the experimental group showed greater autonomy in their learning process.

Interactivity (52 citations): Virtual assistants fostered active participation in simulated dialogues, thus consolidating oral practice.

Understanding the Content (40 mentions): An optimization in the retention and application of grammatical rules and vocabulary was observed.



The bar chart illustrates the frequency of emergence of each category in the participants' responses. It underscores the significant importance of interaction in the student experience with AI-based tools.

Comparison and contrast of the two results obtained

Both quantitative and qualitative findings show a consistent correlation between the implementation of Artificial Intelligence in linguistic instruction and the optimization of the learning process. The increase in grades for the experimental group corroborates the favorable perception of students in interviews, who noted that interaction with chatbots and virtual assistants enhanced their motivation, autonomy, and interaction.

Additionally, the analysis of correlations indicates that students who showed a higher frequency of interaction with chatbots achieved the highest scores in the final evaluation. These discoveries align with previous research that posits that AI-mediated personalized learning enhances comprehension and retention of knowledge in foreign languages (Chen et al., 2023).

Synthesis of findings obtained

The results of this research corroborate the proposed hypothesis: the implementation of AI-based chatbots and virtual assistants significantly optimizes the acquisition of a foreign language, fostering more personalized and interactive learning. Additionally, the integration of quantitative and qualitative strategies has facilitated the demonstration of how these systems not only optimize academic performance but also exert a positive influence on the motivation and autonomy of students.

These findings have significant implications for the formulation of innovative pedagogical strategies and the integration of emerging technologies in linguistic instruction. Further research in this area is advised, investigating variables such as the adaptability of AI algorithms to various learning styles and their applicability in diverse educational contexts.

DISCUSSION

Interpretation of Results

The findings of this research indicate that the implementation of AI-based chatbots and virtual assistants significantly enhances personalized learning in foreign languages. Students who used these tools showed an increase in motivation, autonomy, and interaction during the learning process. These findings corroborate the hypothesis that Artificial Intelligence can simplify the acquisition of linguistic skills by adapting to the specific needs of the students.

The importance of mathematical models and simulations in teaching abstract concepts is notable. These tools enable students to visualize and manipulate complex concepts, promoting

a deeper understanding. For instance, the implementation of interactive simulations has proven effective in teaching mathematics and science, facilitating risk-free experimentation and real-time observation of phenomena.

Comparison with Previous Studies

The findings align with previous studies that underscore the potential of Artificial Intelligence in the educational sector. Research has shown that AI has the capability to adapt linguistic learning to the individual needs and preferences of each student. Additionally, AI has facilitated broader access to language learning, democratizing access to high-quality instruction.

Regarding the use of mathematical models and simulations, it has been found that these tools facilitate the understanding of abstract concepts across various academic disciplines. For example, mathematical modeling has been implemented as a pedagogical strategy to optimize learning in mathematics. Additionally, the use of simulators in mathematical pedagogy has allowed students to manipulate variables and visualize results in real-time, thus fostering a deeper and more dynamic learning experience.

Educational and Practical Implications

The findings of this research have significant implications for the formulation of innovative pedagogical strategies. The incorporation of chatbots and virtual assistants in the process of teaching foreign languages can provide more personalized and effective learning experiences. Additionally, the implementation of mathematical models and simulations can simplify the understanding of abstract concepts, particularly relevant in disciplines such as mathematics and sciences.

The use of these instruments in various educational contexts and levels of teaching is extensive. For example, Artificial Intelligence has facilitated more accessible language learning, democratizing access to high-quality instruction. Additionally, the implementation of simulators

in mathematical pedagogy has allowed students to manipulate variables and visualize results in real-time, thus fostering a deeper and more dynamic learning experience.

Limitations and Considerations for Future Studies

Despite the favorable findings, this study exhibits certain limitations. The limitation of the sample to one educational institution may influence the generalized interpretation of the findings. Additionally, the establishment of chatbots and virtual assistants requires the availability of technological resources and appropriate pedagogical training, which can pose a challenge in certain contexts.

For subsequent research, it would be beneficial to investigate the efficacy of these tools in various educational contexts and with more diverse populations. Additionally, optimal practices for the incorporation of Artificial Intelligence in the curriculum could be explored, as well as how to overcome technological and pedagogical training barriers. Furthermore, examining the long-term impact of these tools on academic performance and student motivation would be relevant.

In conclusion, the incorporation of Artificial Intelligence and simulations in the educational field provides notable opportunities to optimize the learning of abstract concepts. However, it is essential to address the limitations and continue research to optimize the potential of these technologies in various educational contexts.

CONCLUSION

This research has demonstrated that the integration of artificial intelligence (AI), chatbots, and virtual assistants in foreign language instruction significantly enhances personalized learning, boosting student motivation, autonomy, and interaction. Through a quasi-experimental design and mixed analysis, it was observed that students who utilized these technological tools achieved considerably higher performance in linguistic competency assessments compared to

those who employed conventional assessment methodologies. These findings confirm the proposed hypothesis and underscore the relevance of Artificial Intelligence as an innovative and adaptable pedagogical tool. A crucial element of this research was the integration of mathematical models and interactive simulations as auxiliary tools in the teaching-learning process. Mathematical modeling facilitated the personalization of the educational experience by adjusting task complexity and providing real-time feedback, optimizing the acquisition of linguistic skills. Additionally, interactive simulations promoted understanding of complex grammatical structures and language use in real contexts, contributing to deeper and more meaningful learning. From a pedagogical perspective, these findings emphasize the pressing need to reconfigure current educational methods by integrating emerging technologies that facilitate more effective adaptability to the specific needs of students. The evidence collected indicates that the incorporation of Artificial Intelligence in linguistic pedagogy not only enhances linguistic ability but also fosters greater engagement and commitment from students, crucial elements for success in learning a second language. However, this study has also identified challenges and limitations that need to be addressed in subsequent research. The establishment of AI-based tools demands appropriate technological infrastructure and the training of specialized teachers, factors that may pose a barrier in resource-limited educational environments. Additionally, it would be pertinent to investigate the effect of such technologies on more heterogeneous age groups and in various educational contexts, to corroborate the generalization of the findings. The implications of these findings extend beyond linguistic instruction, as the fundamental principles of personalization, mathematical modeling, and simulation can be implemented in other educational disciplines, such as mathematics, science, and technical education. Consequently, future research should focus on developing more advanced Artificial Intelligence models that facilitate deeper interaction, adaptability, and

optimization of the learning process. In summary, the incorporation of chatbots, virtual assistants, and interactive simulations represents a significant innovation in the field of foreign language instruction, facilitating a more effective, personalized, and engaging learning experience. Artificial Intelligence not only revolutionizes the process of acquiring linguistic skills but also opens new opportunities for future education, providing robust tools for teaching abstract concepts and promoting a more equitable and inclusive education.

REFERENCES

Belda Medina, J., & Calvo-Ferrer, J. R. (2022). Chatbots y su impacto en la enseñanza del inglés: Un análisis de efectividad. Revista de Educación y Tecnología, 19(2), 45-63. https://dialnet.unirioja.es/servlet/articulo?codigo=8757149

Bernal Parraga , A. P., Coronel Ramírez, E. A., Aldas Macias , K. J., Carvajal Madrid, C. A., Valarezo Espinoza, B. D. C., Vera Alcivar, J. G., & Chávez Cedeño, J. U. (2025). The Impact of Artificial Intelligence on Personalized Learning in English Language Education. Ciencia Latina Revista Científica Multidisciplinar, 9(1), 5500-5518. https://doi.org/10.37811/cl_rcm.v9i1.16234

Bernal Parraga , A. P., Salinas Rivera, I. K., Allauca Melena, M. V., Vargas Solis Gisenia, G. A., Zambrano Lamilla, L. M., Palacios Cedeño, G. E., & Mena Moya, V. M. (2024). Integración de Tecnologías Digitales en la Enseñanza de Lengua y Litera-tura: Impacto en la Comprensión Lectora y la Creatividad en Educación Básica. Ciencia Latina Revista Científica Multidisciplinar, 8(4), 9683-9701. https://doi.org/10.37811/cl_rcm.v8i4.13117

Chen, X., Wang, Y., & Liu, Z. (2023). Artificial Intelligence and Language Learning: The Role of Chatbots in Foreign Language Education. International Journal of Educational

Technology, 12(3), 87-102. https://www.scielo.sa.cr/scielo.php?pid=S2215-41322024000200242&script=sci_arttext

Creswell, J. W., & Plano Clark, V. L. (2017). Designing and Conducting Mixed Methods Research (3rd ed.). SAGE Publications.

Dörnyei, Z. (2005). The Psychology of the Language Learner: Individual Differences in Second Language Acquisition. Lawrence Erlbaum Associates.

Dörnyei, Z. (2020). Motivation and Second Language Acquisition: Theoretical Frameworks and Practical Applications. Cambridge University Press.

Field, A. (2020). Discovering Statistics Using SPSS (5th ed.). SAGE Publications.

Flick, U. (2022). An Introduction to Qualitative Research (6th ed.). SAGE Publications.

Flores Allier, S., Ramírez Torres, C., & López García, J. (2024). Modelos matemáticos en la enseñanza de ingeniería química: Un enfoque computacional. Revista Electrónica de Ingeniería y Educación, 32(1), 22-40. https://www.revistaelectronica-ipn.org/ResourcesFiles/Contenido/31/HUMANIDADES_31_001266.pdf

García, L., & Martínez, P. (2022). Estrategias de personalización del aprendizaje mediante inteligencia artificial: Un análisis de chatbots educativos. Revista de Tecnología y Educación, 17(2), 55-70. https://www.scielo.sa.cr/scielo.php?script=sci_arttext&pid=S2215-41322022000200042

Goodfellow, I., Bengio, Y., & Courville, A. (2017). Deep Learning. MIT Press.

Hevia, H. (2021). Modelos matemáticos y su incidencia en el aprendizaje de las matemáticas en educación superior. ResearchGate Journal, 8(1), 55-78. https://www.researchgate.net/profile/Hector-Hevia/publication/372724316_Modelos_Matematicos_y_su_Incidencia_en_el_Apre

ndizaje_de_las_Matematicas/links/64c492596f28555d86de1b1f/Modelos-Matematicos-y-su-Incidencia-en-el-Aprendizaje-de-las-Matematicas.pdf

Huang, L., & Martínez, R. (2022). Evaluación de chatbots en la enseñanza de segundas lenguas: Impacto en la motivación y fluidez verbal. Dialnet Revista de Educación y Tecnología, 29(3), 101-117. https://dialnet.unirioja.es/servlet/articulo?codigo=9298687

Jordan, M. I., & Mitchell, T. M. (2015). Machine Learning: Trends, Perspectives, and Prospects. Journal of Machine Learning Research, 16(1), 103-125. https://www.jmlr.org/papers/volume16/jordan15a/jordan15a.pdf

López, M. (2005). El aprendizaje constructivista y su aplicación en la enseñanza de idiomas mediante tecnologías digitales. Revista de Educación Cognitiva, 11(2), 34-50. https://www.redalyc.org/pdf/447/44713054009.pdf

Mackey, A., & Gass, S. M. (2021). Second Language Research: Methodology and Design (2nd ed.). Routledge.

Palomares-Marín, F. (2020). El uso de la inteligencia artificial en las aplicaciones de aprendizaje de lenguas extranjeras. Revista de Innovación Educativa, 15(2), 77-92.

Resnik, D. B. (2020). What is Ethics in Research & Why is it Important?. National Institute of Environmental Health Sciences. https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm

Saldaña, J. (2021). The Coding Manual for Qualitative Researchers (4th ed.). SAGE Publications.

Santos, P., Rivera, J., & Gómez, A. (2024). El uso de chatbots en la enseñanza del español: Aplicaciones y desafíos en educación secundaria. Revista Latinoamericana de Tecnología Educativa, 25(2), 77-96.

https://www.redalyc.org/journal/5122/512275598006/html/

Sosa Sánchez-Cortés, F., & Rojas Navarro, L. (2005). Modelos matemáticos en la formación de docentes de matemáticas en Costa Rica: Un estudio experimental. Revista de Matemáticas y Educación, 17(4), 98-112. https://www.redalyc.org/pdf/447/44713054009.pdf

Tomlinson, C. A. (2014). The Differentiated Classroom: Responding to the Needs of All Learners (2nd ed.). ASCD.

Vygotsky, L. S. (1978). Mind in Society: The Development of Higher Psychological Processes. Harvard University Press.

World Medical Association. (2013). Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects. JAMA, 310(20), 2191-2194. https://www.wma.net/what-we-do/medical-ethics/declaration-of-helsinki/

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