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Analysis of the effect of a NLP chatbot on undergraduate enrollment and admissions at the University of Nariño

Análisis del efecto de un chatbot con PLN en inscripciones y admisiones de pregrado en la Universidad de Nariño

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Abstract: This article presents the design, development, and analysis of the implementation of the chatbot called VyCla, based on Natural Language Processing and integrated with WhatsApp, built to support undergraduate enrollment and admission processes at the University of Nariño. The tool was developed using the agile SCRUM methodology, while the research adopted a quantitative approach based on user surveys to evaluate its effectiveness in terms of response times, satisfaction, and usefulness. The results show that VyCla reduces response times, decreases the operational workload of the staff of the Office of Control, Academic Records, and Admissions (OCARA), and contributes to institutional digital transformation, with possibilities for extension to other academic and administrative processes.

Keywords: natural language processing (NLP), process automation, chatbot, artificial intelligence, higher education.

Resumen: Este artículo expone el diseño, desarrollo y análisis de la implementación del chatbot denominado VyCla, basado en Procesamiento de Lenguaje Natural e integrado con WhatsApp, construido para apoyar los procesos de inscripción y admisión a pregrado en la Universidad de Nariño. El desarrollo de la herramienta se realizó bajo la metodología ágil SCRUM, mientras que la investigación adoptó un enfoque cuantitativo fundamentado en encuestas a usuarios para evaluar su efectividad en términos de tiempos de respuesta, satisfacción y utilidad. Los resultados demuestran que VyCla reduce los tiempos de atención, disminuye la carga operativa de los funcionarios de la Oficina de Control, Registro Académico y Admisiones (OCARA) y contribuye a la transformación digital institucional, con posibilidades de extensión hacia otros procesos académicos y administrativos.

Palabras clave: procesamiento del lenguaje natural (PLN), automatización de procesos, chatbot, inteligencia artificial, educación superior.

1. INTRODUCTION

Learning, conceived as an active and continuous process, has been transformed by advances in Information and Communication Technologies (ICT), which have become key tools for optimizing academic management and administrative efficiency [1]. In particular, Artificial Intelligence (AI) and Natural Language Processing (NLP) enable the creation of conversational agents through various architectures, including rule-based systems that respond according to predefined flows and conditions [2], response retrieval models that select existing responses based on similarity to user queries [3], approaches that classify user intentions to trigger responses or actions [4], and hybrid architectures that combine rules, retrieval, and generation for flexible responses [5] and integrate multiple approaches to understand and respond effectively [6], facilitating fluid communication by training in grammar and common slang [7]. This technological evolution responds to a critical problem in higher education: the operational imbalance in admissions offices such as the Office of Control, Academic Records, and Admissions (OCARA) at the University of Nariño, which in 2022 managed the applications of 15,522 applicants with limited staff [8]. The reliance on manual and repetitive processes, coupled with restricted office hours, creates information bottlenecks that increase the risk of applicants dropping out due to a lack of immediate response.

In this context, this research is based on an intent classification approach for the design and development of the VyCla chatbot. The system uses a modular architecture based on Node.js and Python to process text and audio automatically. The objective of this study is to analyze the effect of implementing VyCla as a support tool in the undergraduate enrollment and admission process at the University of Nariño, quantitatively evaluating its efficiency in reducing response times and the level of satisfaction perceived by users.

2. METHODOLOGY

2.1. Diagnosis and data collection

The first phase of this research aimed to characterize the processes of the Office of Control, Academic Records, and Admissions (OCARA) and identify the information needs of users. To this end, three surveys were administered to different audiences using a finite population sample: (i) 4 university officials, (ii) 105 currently enrolled students, and (iii) 45 prospective applicants to undergraduate programs [9], specifically 11th-grade students from the Iberia and ITPC educational institutions in the municipality of Tumaco (N), in order to identify activities and/or characteristics feasible for automation [10].

2.2. Requirements and processes

In this phase, a systemic analysis of the data collected in the diagnostic stage was carried out to define the functional design of the VyCla chatbot [11]. The main selection criterion was the identification of repetitive administrative tasks that required a high level of information and generated operational bottlenecks in the OCARA office.

2.3. Development and integration

Phase 3 covers the development of the tool. We worked with the SCRUM methodology due to its agile and structured approach, facilitating the incremental delivery of the project through five sprints [12], allowing for efficient development management, collaboration among project members, rapid adaptation to adjustments in chatbot requirements, and improvement of the prototype based on feedback from each sprint [13].

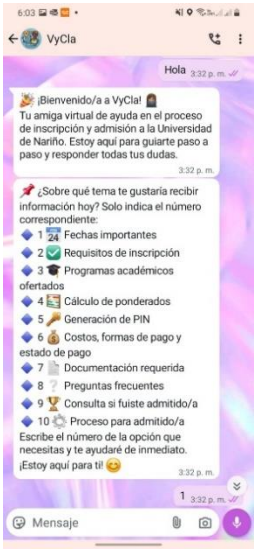

***Fig. 1**. First version of VyCla with options menu.*
***Source:** own elaboration.*

For the first version of the VyCla chatbot, Node.js v20.11.0 and the Baileys library [14] were integrated, allowing interaction with the WhatsApp API and establishing a connection with PostgreSQL v17 [15]. This rule-based version implemented an options menu, where the user responded specifically

with a number. An example of how this first version worked is shown in (Fig. 1).

In the version mentioned in (Fig. 1), the functional requirements defined in the sprints were not yet fully covered, so it was necessary to supplement it by incorporating a data set with the information needed to build a PLN model [16] and proceed with its training. The data was consolidated based on the characterization of OCARA processes and underwent preprocessing involving tokenization, normalization (conversion to lowercase), stopword removal, and lemmatization (Fig. 2), resulting in a vocabulary of unique tokens with 3,989-dimensional vectors using techniques such as Bag of Words, which defines the high dimensionality of the input vectors [17].

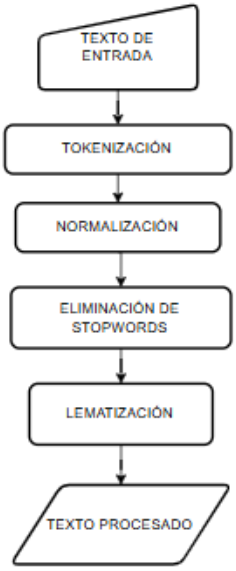

***Fig. 2**. NLP techniques implemented.*
***Source:** own elaboration*

To validate the model, an 80% data split was applied for training and 20% for validation.

The architecture of the VyCla tool consists of three main modules: (i) the conversational logic in Node.js v20.11.0 that communicates with WhatsApp via Baileys (ii) the API built with Flask 2.3.2 and the NLTK NLP library (iii) and the audio transcription API using the Whisper library [18]. The latter two are built in Python 3.12.1 [15]. Information is extracted from institutional websites using web scraping techniques with the Axios and Puppeteer libraries on Node.js v20.11.0 [19], and all messages are stored in a PostgreSQL v17 database [15] as shown in (Fig. 3).

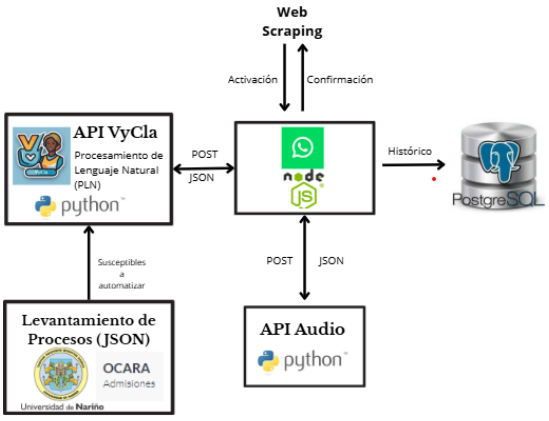

***Fig. 3**. System architecture.*
***Source:** own elaboration*

2.4. Implementation and evaluation

For the fourth phase, first, a comparison was made between the response times for in-person service at the offices (obtained in the diagnostic phase) and the response times for service through VyCla, collected directly from the time of interaction with the chatbot, which were recorded in the system during the evaluation phase. The analysis of the satisfaction and efficiency results was carried out using descriptive statistics (mean, median, and mode) and the application of a t-test for paired samples , which made it possible to mẹasure effectiveness and establish the contribution to reducing the operational burden of the Office of Control, Academic Records, and Admissions (OCARA), as detailed in [20] and [21].

3. RESULTS

3.1. Institutional diagnosis

Table 1 shows the results of the survey, which reveal that WhatsApp is the users' preferred tool.

***Table 1:** Instant messaging tool chosen*

Population	Most voted tool	Total votes	Total, respondents
Civil servants	WhatsApp	4	4
Students	WhatsApp	94	105
Applicants	WhatsApp	41	45

***Source:** own elaboration*

Figure 4 shows the results obtained in relation to the processes that users consider should be automated, where it is evident that there is a significant set of processes that are perceived as feasible to automate, highlighting three of them: (i) the offer of undergraduate programs, (ii) the documentation

required in the selection of applicants, and (iii) the registration requirements.

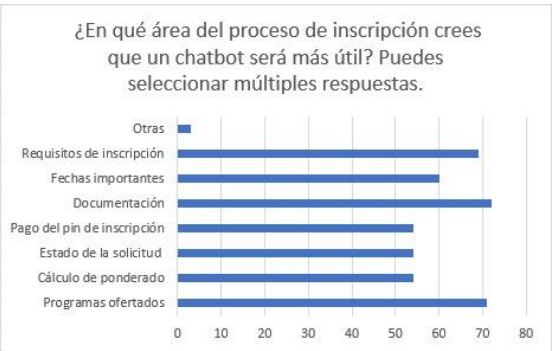

***Fig. 4**. Areas of the enrollment process to be automated*
***Source:** own elaboration.*

In the second phase, based on the analysis of the results obtained, development was planned on WhatsApp, as it is the instant messaging application preferred by most respondents. Similarly, the characterization of the processes susceptible to automation led to the conclusion that these correspond to those described in Table 2.

***Table 2:** Processes feasible for automation*

No.	Name of process	Applicant's question
1	Initial Orientation	What undergraduate programs does the University of Nariño offer? Where can I find information about enrollment costs? What are the enrollment requirements? Where or how do I calculate my weighted average?
2	Requirements and Documentation Management	What documents are required to enroll in an undergraduate program? Where do I generate the registration PIN? How can I check the status of my PIN payment?
3	Dates and Deadlines	What are the important dates to keep in mind? When will the results be published?
4	Results and Admission	What should I do if I am admitted? How will I know if I have been admitted? What is the admission process like?

***Source:** own elaboration*

3.2. Technical architecture

The chatbot's behavior is based on a JSON format structure (IntentsCT.json), as shown in (Fig. 5), and consists of 13,996 training phrases distributed across 21 intents organized in that format. Each intent includes a Tag, which identifies the name of the intent; a Parrents attribute, which corresponds to the questions used to train the model; and a Responses attribute, which contains the possible responses that the chatbot can offer. It is important to note that not all responses come directly from the dataset, as some are obtained using web scraping techniques applied to different websites of the University of Nariño.

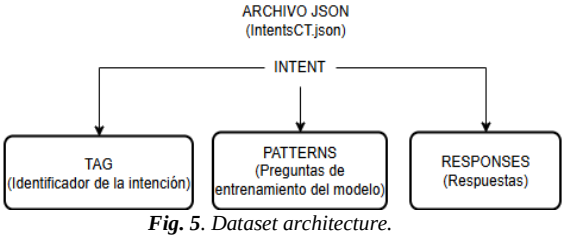

***Fig. 5**. Dataset architecture.*
***Source:** own elaboration*

Fig. 6 shows the interaction between a user and the version of the chatbot that implements NLP, where the PIN payment status is queried, which is one of the functional requirements of the system.

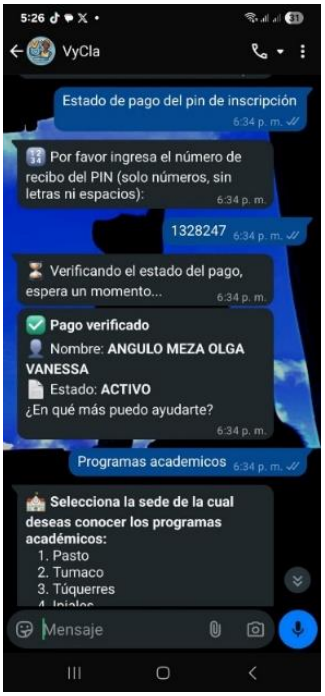

***Fig. 6**. User interaction with the system.*
***Source:** own elaboration*

3.3. Model performance

After applying the aforementioned techniques and completing the model training, key metrics such as accuracy and loss, detailed in (Figs. 7 and 8), were obtained. These values are fundamental indicators for evaluating the model's performance in prediction [22].

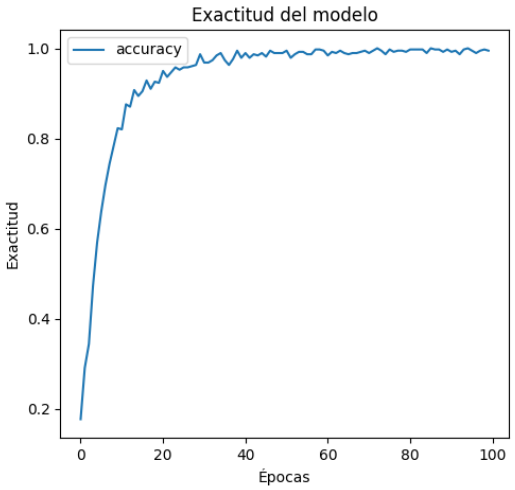

***Fig. 7**. Model accuracy.*
***Source:** own elaboration*

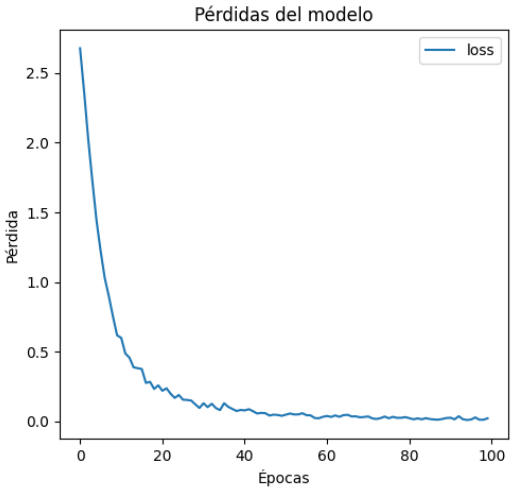

***Fig. 8**. Model loss.*
***Source:** own elaboration*

In this case, an accuracy of 99% (0.99) and a loss of 2% (0.02) were achieved after 100 epochs. These results show that the model achieved an optimal level of learning during the training stage, as the high accuracy reflects that most predictions match the actual values, while the low loss indicates that the errors made are minimal. In practical terms, this means that the model performs reliably enough to be implemented in the context of applicant registration and admission, ensuring accurate responses and reducing the likelihood of errors in the classification or interpretation of applications.

3.4. Operational impact

Table 3 shows the positive impact of the chatbot in terms of efficiency and query resolution in the enrollment and admission process. A comparison of response times between the in-person modality and the chatbot reveals a substantial difference: the use of the chatbot allowed for a 99.81% reduction in response time, reflecting a significant improvement over the averages recorded for in-person service. This decrease confirms that automation using NLP tools contributes decisively to immediacy in service, which is consistent with previous studies that highlight the role of chatbots in optimizing response times in educational services and increasing customer satisfaction by providing timely and effective responses, as detailed in [23] and [24].

***Table 3:** Statistical values of response times in minutes*

Mean (min)	Mean (min)	Median (min)	Mode (min)
In person	666.04	120	60
Chatbot	1.25	0.06	5.00E-05

***Source:** own elaboration*

3.5. Statistical validation

The number of queries resolved was 462, which is significant when compared to the total number of users who interacted with the tool (122), indicating a high level of interaction and good system performance in terms of coverage and relevance of responses. This finding is consistent with the findings of [25], who point out that the effectiveness of chatbots in academic contexts depends largely on their ability to sustain multiple successful interactions with the same user, thereby building trust in the system.

In terms of workload, the reduction in response times and the automatic resolution of a considerable number of queries suggest a reduction in the administrative tasks of OCARA staff and academic secretaries [26]. This condition, in addition to freeing up human resources for more complex tasks, favors the sustainability of the admissions process, as it allows for efficient responses even during periods of high demand.

Finally, the results show that the development of the chatbot not only meets the need to reduce response times, but also constitutes a strategic resource for institutional digital transformation. The experience gained in this phase supports the relevance of continuing to strengthen the tool, seeking to increase its scalability and accuracy, in line with global trends in the use of chatbots in educational environments.

Secondly, the results obtained in terms of the perception of users who interacted with the tool show a high level of acceptance by applicants. Table

4 shows that the average satisfaction score was 4.23 and the average recommendation score was 4.07, according to the Likert scale from 1 to 5 [27]. The median and mode for both variables coincide at 4 and 5, respectively, which shows that most users rated the system positively, both in terms of their experience and their willingness to recommend it to other applicants. A t-test for paired samples was then applied, obtaining a p-value of 0.1788 ($p > 0.05$) with a t-statistic of 1.35. This result confirms that there is no statistically significant difference between satisfaction and recommendation, validating that the positive perception of the system is consistent and not a product of chance.

This coincides with previous studies that have shown that the implementation of chatbots in educational processes improves the perception of institutional efficiency and proximity [28] and [29].

Table 4: *User perception*

Question	Mean	Median	Mode
Recommendation	4.07	5	5
Satisfaction	4.23	4	5

Source: *own elaboration*

With regard to the open question on comments and suggestions, the analysis was based on the records obtained in the survey conducted during the evaluation phase. Twenty-eight responses were received, of which 10 were discarded for lack of meaningful content (containing only punctuation marks or being empty in the database). Thus, 18 valid responses were considered, which provided relevant information for the study. Terms such as "good," "nice," "like," and "thank you" were the most frequently used, reinforcing the positive perception of the system. However, expressions such as "correct," "improvements," "missing," "update," and "loops" were also identified, reflecting critical areas for improvement, especially related to the accuracy of responses and the reduction of repetitions in conversational flows.

These findings allow us to conclude that VyCla achieved its purpose of providing support in the enrollment and admission process by delivering a satisfactory experience for users. However, the comments suggest that the system requires an update of the information and optimization of the conversational logic. This is in line with what is stated in [30], which highlights the importance of constantly providing feedback and adjusting educational chatbots to ensure their effectiveness and relevance.

Finally, the combination of quantitative indicators (means, medians, and modes) with qualitative analysis of the comments allows us to affirm that the chatbot was not only well received, but also generated expectations of continuous improvement on the part of users, as mentioned in the study [31]. This shows that student perception not only serves as an indicator of satisfaction, but also as a valuable tool for guiding the next cycles of development and consolidation of VyCla as strategic support in institutional processes.

4. CONCLUSIONS

The implementation of the VyCla chatbot, based on NLP and integrated with WhatsApp, proved to be an effective technological solution for optimizing information management in the admission processes at the University of Nariño. The system allowed for the incorporation of weak artificial intelligence to automate repetitive tasks such as consulting requirements, dates, and costs, achieving a disruptive impact on the operational efficiency of the OCARA office. The results show a 99.81% reduction in response times, transforming an average face-to-face service time of 666.04 minutes into an immediate digital interaction of 1.25 minutes. With 462 queries resolved autonomously, a significant decrease in the institutional operational load was confirmed.

The perception of applicants was highly favorable, registering an average satisfaction rating of 4.23 and a recommendation rating of 4.07 on the Likert scale. The consistency of these findings was validated using a t-test for paired samples ($p = 0.1788$), which confirmed that the positive assessment by users is statistically stable and not a product of chance.

It is recognized that VyCla is a support tool whose effectiveness is contingent on the structure of its current dataset of 13,996 phrases. As a major technical limitation, the system does not process emojis, emoticons, or colloquial abbreviations, which restricts fluency in informal communications.

Future lines of work include the integration of advanced language models to enhance semantic understanding, the expansion of the dataset to include regional expressions, and the enablement of functions for receiving documents in various formats.

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