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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.

INTRODUCTION

Learning, conceived as an active and continuous process, has been transformed with the advancement of Information and Communication Technologies (ICT), which have become consolidated as key tools for optimizing academic management and administrative efficiency [1]. In particular, Artificial Intelligence (AI) and Natural Language Processing (NLP) allow the creation of conversational agents through various architectures, which include rule-based systems that respond following predefined flows and conditions [2], response retrieval models, which select existing responses by similarity with user queries [3], approaches to classify user intents to activate 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 being trained on grammar and common jargon [7]. This technological evolution responds to a critical problem in higher education: the operational disproportion in admissions offices such as the Oficina de Control, Registro Académico y Admisiones (OCARA) of the Universidad de Nariño, which in 2022 managed the applications of 15,522 applicants with limited staff [8]. The dependence on manual and repetitive processes, together with restricted service hours, generates informational bottlenecks that increase the risk of desistance of interested parties due to lack of an 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 the implementation of VyCla as support in the undergraduate enrollment and admission process of the Universidad de Nariño, quantitatively evaluating the efficiency in reducing response times and the level of satisfaction perceived by users.

METHODOLOGY

Diagnosis and data collection

The first phase of this research had the purpose of characterizing the processes of the Oficina de Control, Registro Académico y Admisiones (OCARA) and identifying the information needs of users; for this, three surveys were applied to different audiences through finite population sampling: (i) 4 University staff members, (ii) 105 currently enrolled students, and (iii) 45 future applicants seeking admission 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 the activities and/or characteristics feasible for automation[10].

Requirements and processes

In this phase, the data collected during the diagnostic stage were analyzed systemically to define the foundations of the functional design of the VyCla chatbot[11]. The main selection criterion was the identification of repetitive administrative tasks that had a high information demand and generated operational bottlenecks in the OCARA office.

Development and integration

Phase 3 covers the development of the tool. Work was carried out with the SCRUM methodology, due to its agile and structured approach, facilitating the incremental delivery of the project through 5 sprints[12], enabling: efficient development management, collaboration among project members, rapid adaptation to adjustments in the chatbot requirements, and improvement of the prototype based on the feedback from each sprint[13].

For the first version of the VyCla chatbot, Node.js v20.11.0 and the Baileys library[14]were integrated, which allows interaction with the WhatsApp API, establishing a connection with PostgreSQL v17[15]. This rule-based version implemented an options menu, in which 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 complement it by incorporating a data set with the information needed to build an NLP model[16]and proceed with its training. The data were consolidated from the characterization of OCARA processes and underwent preprocessing consisting of tokenization, normalization (conversion to lowercase), removal of stopwords, and lemmatization (Fig. 2), resulting in a vocabulary of unique tokens, with 3,989-dimensional vectors under techniques such as Bag of Words, which defines the high dimensionality of the input vectors[17].

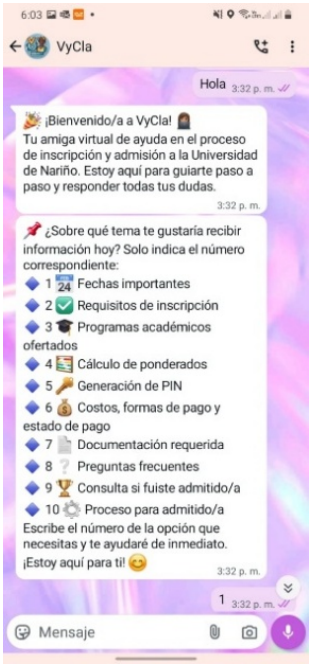

Fig. 1. *First version of VyCla with an options menu.*
Source: own elaboration.

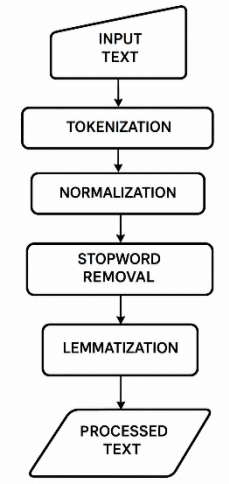

Fig. 2. *NLP techniques implemented.*
Source: own elaboration

For the validation of the model, a data split of 80% for training and 20% for validation was applied.

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 library of PLN (iii) and the audio transcription API using the Whisper library[18]. The last two built in Python 3.12.1[15]. Information is extracted from institutional websites using web scraping techniques using the Axios and Puppeteer libraries on Node.js v20.11.0[19], and all messages are stored in a PostgreSQL v17 database[15]como se muestra in the (Fig. 3).

Implementation and evaluation

For the fourth phase, first, a comparison was made between the in-person service response times at the offices (obtained in the diagnostic phase) and the service response times through VyCla, collected directly from the interaction time with the chatbot, which were recorded in the system during the evaluation phase. The analysis of the satisfaction and efficiency results was performed using descriptive statistics (mean, median, and mode) and the application of a paired-samples t-test, which made it possible to measure effectiveness and establish the contribution to the reduction of the operational workload of the Oficina de Control, Registro Académico y Admisiones (OCARA), as detailed in[20]and[21].

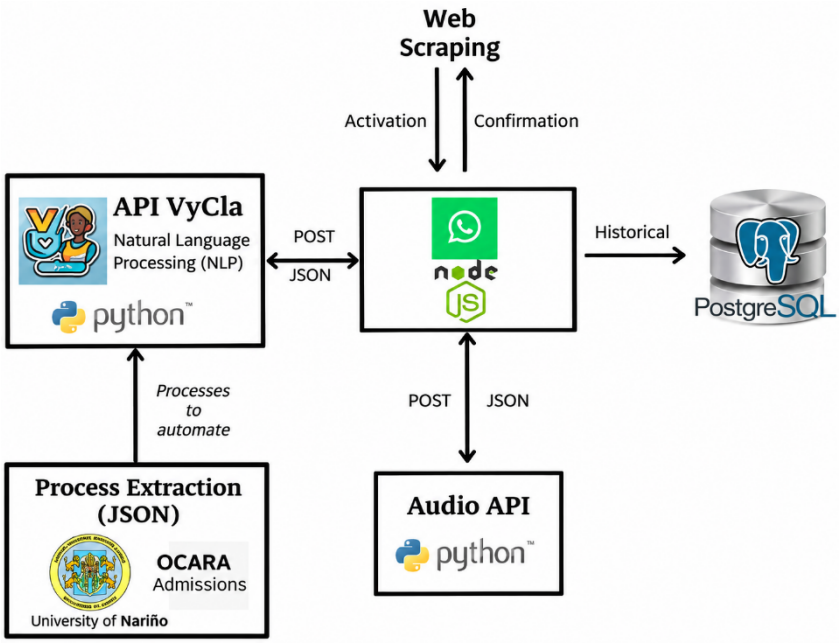

Fig. 3. *System architecture.*
Source: own elaboration

RESULTS

Institutional diagnosis

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

Table 1: Instant messaging tool chosen

Population	Most voted tool	Total votes	Total respondents
Staff	WhatsApp	4	4
Students	WhatsApp	94	105
Applicants	WhatsApp	41	45

Source: own elaboration

Fig. 4 shows the results for the processes that users consider should be automated. A substantial set of processes is perceived as feasible to automate, and three of them stand out: (i) the offering of undergraduate programs, (ii) the documentation required in the selection of applicants and (iii) the enrollment requirements.

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

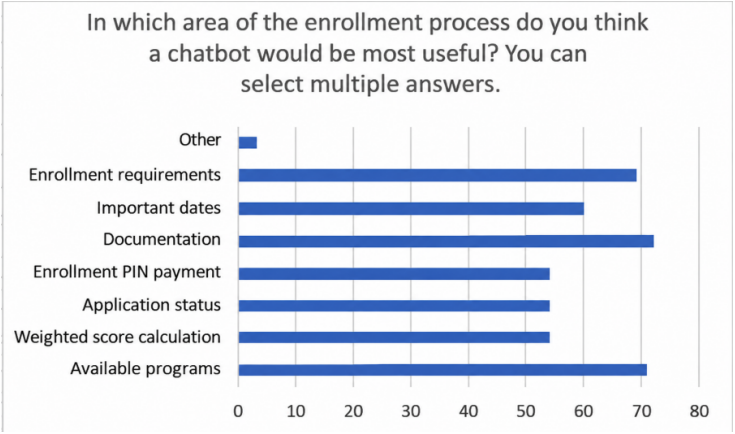

Fig. 4. *Areas of the enrollment process to be automated*
Source: own elaboration.

Table 2: Processes feasible for automation

No.	Process name	Applicant's question
1	Initial Guidance	What undergraduate programs is the Universidad de Nariño offering? Where can I find information about enrollment costs? What are the enrollment requirements? Where or how do I calculate the weighted scores?
2	Requirements and Documentation Management	What documents are required for enrollment in an undergraduate program? Where do I generate the enrollment PIN? How can I check the payment status of the PIN?
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 can I find out if I was admitted? What is the admission process like?

Source: own elaboration

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 sentences 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 the chatbot can offer. It is important to note that not all responses come directly from the dataset, since some are obtained through Web Scraping techniques applied to different websites of the Universidad de Nariño.

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

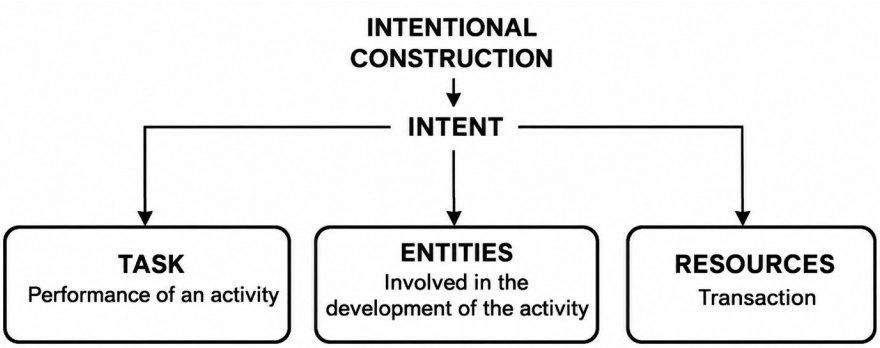

Fig. 5. *Dataset architecture.*
Source: own elaboration

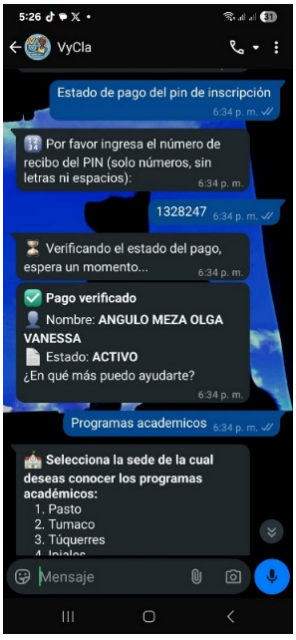

Fig. 6. *User interaction with the system.*
Source: own elaboration

Model performance

After applying the techniques described above and completing the model training, key metrics such as accuracy and loss

were obtained, as detailed in (Figs. 7 and 8). These values are fundamental indicators for evaluating the model's performance in prediction[22].

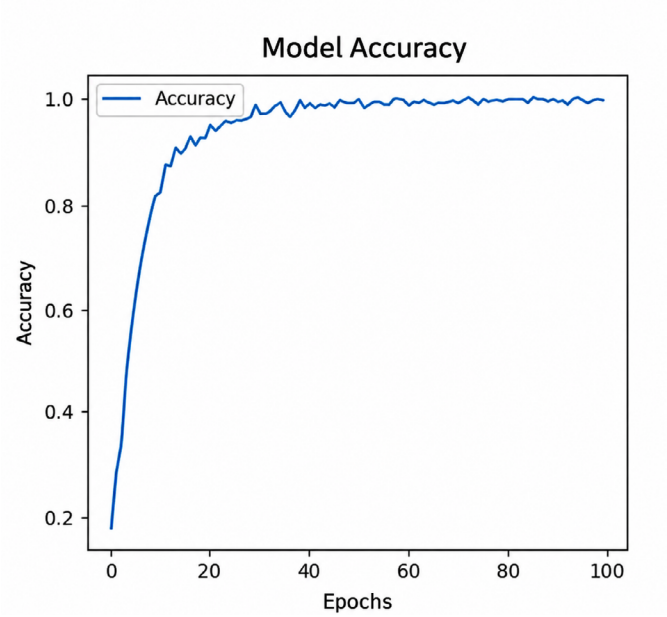

Fig. 7. *Model accuracy.*
Source: own elaboration

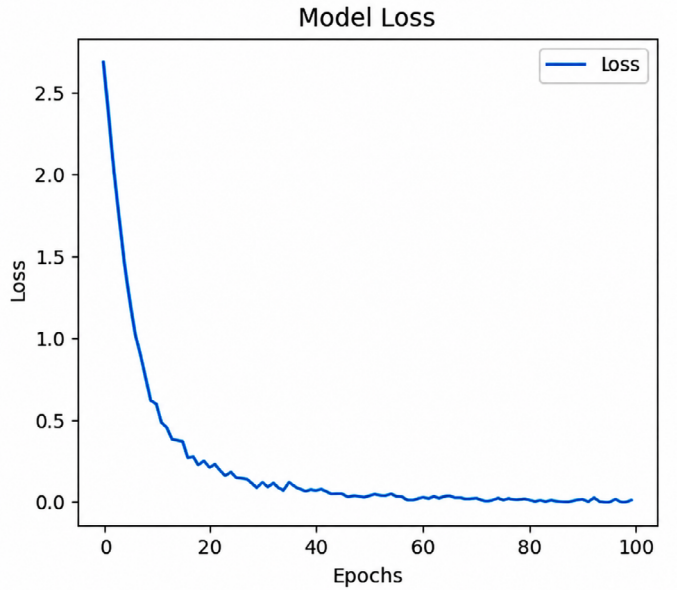

Fig. 8. *Model loss.*
Source: own elaboration

In this case, an accuracy of 99% (0.99) and a loss of 2% (0.02) were reached after 100 epochs. These results show that during the training stage the model achieved an optimal level of learning, since the high accuracy reflects that most predictions match the real values, while the low loss indicates that the errors made are minimal. In practical terms, this means that the model behaves highly reliably for implementation in the context of enrollment and admission of applicants, guaranteeing accurate responses and reducing the probability of failures in the classification or interpretation of applications.

Operational impact

Table 3 shows the positive impact of the chatbot in terms of efficiency and resolution of queries in the enrollment and admission process. The comparison of response times between the in-person modality and the chatbot shows a substantial difference: the use of the chatbot allowed a 99.81% reduction in response time, which reflects a significant improvement compared with

the averages recorded in in-person service. This decrease confirms that automation through 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 in increasing customer satisfaction by receiving timely and effective responses, as detailed in[23]and[24].

Table 3: Statistical values of response times in minutes

Medium (min)	Mean (min)	Median (min)	Mode (min)
In-person	666,04	120	60
Chatbot	1,25	0,06	5.00E-05

Source: own elaboration

Statistical validation

The number of queries resolved was 462, which is significant when compared with 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[25], who point out that the effectiveness of chatbots in academic contexts depends to a large extent on their ability to sustain multiple successful interactions with the same user, generating trust in the system.

In terms of workload, the reduction of response times and the automatic resolution of a considerable number of inquiries suggest relief in the administrative tasks of OCARA officials and academic secretariats[26]. This condition, besides 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 addresses 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 precision, in line with global trends in the use of chatbots in educational environments.

Secondly, the results obtained regarding the perception of users who interacted with the tool show high acceptance by the candidates. Table 4 shows that the average satisfaction was 4.23 and the average recommendation was 4.07, according to the Likert scale from 1 to 5[27]. The median and the mode in both variables coincide at 4 and 5 respectively, which shows that most users rated the system positively, both in terms of experience and their willingness to recommend it to other applicants. Thus, a t-test was applied for matched samples, obtaining a p-value = 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 the result of chance.

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

Table 4: User perception

Question	Mean	Median	Mode
Recommendation	4,07	5	5
Satisfaction	4,23	4	5

Source: own elaboration

For the open-ended question on comments and suggestions, the analysis drew on the records obtained from the survey administered during the evaluative phase. A total of 28 responses were received, of which 10 were discarded for lacking meaningful content (they contained only punctuation marks or were empty in the database). Thus, 18 valid responses were considered, and these provided relevant information for the study. Terms such as “good,” “fine,” “like,” and “thanks” were the most frequent, which reinforces the positive perception of the system. However, expressions such as “correct,” “improvements,” “missing,” “update,” and “loops” were also identified, reflecting critical aspects to be improved, especially those related to the accuracy of responses and the reduction of repetitions in conversational flows.

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

Finally, combining quantitative indicators (means, medians, and mode) with the qualitative analysis of the comments allows us to affirm that the chatbot was not only well received but also generated expectations of continuous improvement among 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 to guide the upcoming cycles of development and consolidation of VyCla as strategic support in institutional processes.

CONCLUSIONS

The implementation of the VyCla chatbot, based on NLP and integrated into WhatsApp, proved to be an effective technological solution for optimizing information management in the admission processes of the Universidad de Nariño. The system made it possible to incorporate weak artificial intelligence to automate repetitive tasks such as queries about 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 a mean in-person 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 workload was confirmed.

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

VyCla is acknowledged to be a support tool whose effectiveness depends on the structure of its current dataset of 13,996 sentences. As a main technical limitation, the system does not process emojis, emoticons, or colloquial abbreviations, which restricts fluency in informal communications.

As future lines of work, we propose integrating advanced language models to improve semantic comprehension, expanding the dataset toward regional expressions, and enabling functions for receiving documents in various formats.

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