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AI in Philippine Nursing Education: Exploring Chatbot Use for Pharmacology Instruction

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Abstract: *This study explores the experiences of nursing students and faculty with a pedagogical conversational agent (PCA) designed to support pharmacology instruction in a nursing program in the Philippines. Addressing gaps identified in existing literature, the study emphasizes the need for a comprehensive examination of chatbot functionality in educational contexts. Using a mixed methods design, findings reveal the PCA's potential to improve accessibility, promote self-directed learning, and serve as an effective supplementary teaching tool. Challenges such as technical limitations and connectivity issues highlight the importance of thoughtful design and contextual adaptation in the integration of PCAs into nursing education.*

Keywords: chatbot; nursing education; pedagogical conversational agent (PCA), pharmacology; mixed methods

1. INTRODUCTION

Artificial Intelligence (AI) is a transformative technology of the Fourth Industrial Revolution, reshaping human experiences in profound and often unexpected ways [1]. In the field of education, AI has enabled new opportunities for personalized, adaptive, and scalable learning. Among these innovations, pedagogical conversational agents (PCAs), commonly known as chatbots, have gained attention as promising tools for delivering interactive and student-centered educational experiences. Leveraging natural language processing, PCAs simulate human-like dialogue using trained, labeled datasets to support instruction, assessment, and learner engagement [2]. Although chatbots are widely utilized in business and customer service settings, their application in healthcare education particularly in nursing remains a developing area that requires thorough exploration and evaluation.

In nursing education, where clinical reasoning, contextual understanding, and real-time decision-making are critical, the use of AI systems like PCAs presents both compelling opportunities and significant challenges [3]. On one hand, PCAs can bridge learning gaps through on-demand support and autonomous review tools. On the other hand, concerns persist about content accuracy, student engagement, and technological barriers. As the literature on AI in education grows, researchers have highlighted the need for in-depth, context-specific analyses of chatbot integration within specific disciplines, including health sciences.

This study addresses this gap by examining the effectivity of a PCA named Rexy as a learning tool and exploring the experiences of nursing students and faculty members at a state university in the Philippines who interacted with it. Developed as a message-based learning assistant for a pharmacology course, Rexy aimed to supplement traditional instruction through accessible, structured content [4]. By documenting user experiences and synthesizing themes from their interactions, this study aims to contribute to the growing body of research on digital learning tools in nursing. It also sheds light on how AI technologies can be tailored to support the complex learning needs of healthcare professionals in training.

The novelty of this study lies in the following areas. First, this study expands the limited literature on the application of chatbots in education. Second, it incorporates mixed methods design, which provides a more in-depth exploration of participants' experiences in navigating chatbots.Third, this pioneering study conducted in a Philippine province stands out from the dominance of AI research in education by China and Taiwan in Asia [5], bringing novel insights and new perspectives. Lastly, it identifies promises and challenges related to using chatbot systems on the learners' end.

2. METHODOLOGY

This study employed an explanatory sequential mixed-methods design, specifically integrating a quantitative one-group pre-test-posttest design with qualitative interviews. The quantitative component aimed to determine whether there was a significant difference in the learning performance of the respondents before and after using the PCA, while the qualitative component sought to explore participants' perceptions, experiences, and insights in depth.

2.1 Hypothesis

There is no significant difference in the pharmacology knowledge scores of respondents before and after the use of PCA.

2.2 Participants

In the quantitative phase, the study involved 66 Level 2 nursing students who served as respondents. For the qualitative phase, 14 participants were selected, comprising 11 students and 3 faculty members from the Nursing Department from a state university in the Philippines who interacted with the PCA for a period of two weeks. All participants voluntarily agreed to take part in the study. Purposive sampling was employed to ensure the selection of individuals with direct experience using the PCA.

2.3 Quantitative Phase: One-group Pre-test-Posttest Design

In one group pretest-posttest design, a dependent variable(O_1) is introduced to an experimental manipulation (X). After the experimental treatment, a dependent variable is measured again (O_2) [6]. It can be represented as:

Experimental O_1 X1 O_2

The procedures of the one-group pre-test-posttest design were described as follows: (1) administering a pre-test that was proposed to measure respondents' knowledge of pharmacology before the treatment;(2) applying the intervention where the respondents learned through a chatbot and (3) administering a post-test that was proposed to measure respondents' knowledge of pharmacology after the treatment.

A 30-item objective test was used during the pre-test and post-test. The test items covered topics included in the PCA content and were aligned with the course objectives. The instrument was pilot-tested and found to be reliable, with a Cronbach's Alpha coefficient of 0.718.

To interpret the learning performance of the respondents, the researcher-constructed scale in Table 1 was used:

Table 1. respondents research scale

Test Scores	Description	Interpretation
0-6	Very Low	The respondents performed very poorly in the test
7-12	Low	The respondents performed poorly in the test
13-18	Average	The respondents performed satisfactorily in the test.
19-24	High	The respondents performed very satisfactorily in the test.
25-30	Very High	The respondents performed excellently in the test.

Pretest and Posttest Scores were compared using t-test. Descriptive statistics such as frequency, mean, standard deviation and percentage gains were also computed.

2.4 Qualitative Phase: Interviews

To complement the quantitative findings, semi-structured interviews were conducted to 14 participants after the posttest. The participants consisted of 11 nursing students and three faculty members who actively engaged in the implementation of the PCA as a learning and teaching tool.

A researcher-made interview guide was used, which underwent validation by language and research experts. It had five parts: 1) establishing rapport, 2) experiences on the use of a chatbot, 3) coping mechanism (if any), 4) insights, and 5) other comments and suggestions. During the interview, the participants were asked to answer the questions in the language they were comfortable using.

The collected interview data underwent a thematic analysis, which entailed carefully examining, identifying, and documenting patterns or themes derived from students' experiences using the developed PCA. The analysis followed the six-phase framework that Braun and Clarke [7] outlined. These phases include 1) familiarizing oneself with the data, 2) generating initial codes, 3) searching for themes, 4) reviewing themes, 5) defining and naming themes, and 6) producing the report. All recorded interviews were transcribed verbatim, and significant quotations used in this study were translated into English. At last, it was used to analyze the transcribed interviews.

To ensure rigor and trustworthiness in the research, the researcher employed peer debriefing as a validation technique [8]. This involved having two practitioners of qualitative research, who were employed in a state university, to review and assess the transcripts, methodology, and findings of the study. The purpose of this peer debriefing was to gain an external perspective and verify the accuracy and credibility of the codes and final themes identified in the research. Any disagreements or discrepancies regarding the coding and themes were thoroughly discussed and resolved through constructive dialogue between the researchers and the peer debriefers. This process helped enhance the reliability and validity of the study by addressing potential biases and ensuring that the research findings accurately represented the data collected.

2.5 Ethical Considerations

Prior to their involvement, informed consent was obtained from the participants, ensuring they were aware of the voluntary nature of their participation and their right to withdraw without any repercussions. Additionally, participants were given the option to decline to answer specific questions. It was emphasized that confidentiality would be maintained through pseudonyms to protect their identities, and their responses would be analyzed while preserving anonymity.

3. RESULTS AND DISCUSSION

3.1 Learning Performance of Students Before and After Using the Chatbot

Table 2 presents the pretest and posttest results of the respondents. There were 66 respondents who took the pretest and posttest. Before utilizing the chatbot Rexy, two of the participants scored Very Low, thirty-six (36) scored Low, twenty-seven (27) scored Average, and one (1) scored High. Overall, the students had a mean score of 12.1, which is low. This means that the students performed poorly on the test. In addition, the scores show that there is a 2.79 disparity from the mean. Hence, the pretest scores of the students are heterogeneous.

On the other hand, during the posttest, no participant scored Very Low, twenty-eight (28) scored Low, thirty-three (33) scored Average, and five (5) scored High. Overall, the students had a mean of 13.29, which means students performed satisfactorily on the test. It shows that students performed better in the posttest than in the pretest. Moreover, the standard deviation of 3.11 indicates that the posttest scores show disparity. Therefore, the posttest scores of the students are heterogeneous.

Table 2. Mean Scores of the Respondents in Pretest and Posttest

Scores	Pre-test		Post-Test	
	f	%	f	%
0 – 6	2	3.03	0	0.00
7 – 12	36	54.55	28	42.42
13 – 18	27	40.91	33	50.00
19 -24	1	1.51	5	7.58
25 – 30	0	0.00	0	0.00
Total	66	100	66	100
Mean	12.09		13.29	
SD	2.79		3.11	
Description	Low		Average	

3.2 Difference between the pre-test and post-test scores of the students

Table 3 presents the difference between the pre-test and post-test scores of the students in NCM 106 - Pharmacology. The mean pretest score is 12.09, while the mean posttest score is 13.29. It has a p-value of 0.004* at a 0.05 level of significance. Hence, it rejects the null hypothesis. There is a significant difference between the pretest and posttest scores of the respondents. The post-test scores are significantly higher than the pretest scores. Therefore, the results suggest that the PCA (Rexy) is an effective learning tool for NCM 106 Pharmacology.

Table 3. Difference Between the Pre-test and Post-test Scores of the Respondents

	Mean	Mean Gain	df	t-value	p-value	Interpretation
Pretest Posttest	12.09 13.29	1.2	65	3.014	0.004*	Significant

3.3 Learning Experiences While Navigating Rexy

A total of 168 codes were generated from the transcribed interviews. These codes served as the bases for the developing the four themes such as "learning experiences" (learning *and navigating the features of Rexy*) with 84 codes; "adjustments" (*strategies adopted by users to the limitation of Rexy*) with 12 codes; "insights gained" (*attitude of users after engaging with Rexy*) with 51 codes; and "suggestions for further improvement" (*recommendations of users to improve Rexy further*) with 21 codes as shown in Fig. 4.

The learning experiences of PCA users focused on learning the features and navigating buttons to get to the information wanted. All users agree that the interactive design of Rexy, is a source of fast and easy information available anytime, online or offline. Sarah best encapsulates the observation of all users when she said,

> *The best feature of Rexy is how interactive it is with the person using it; I mean, it is like having a personal interaction. There is no dead air since every time you hit a button or throw a question there, the answers are ready. Moreover, the explanations are given in a lot of options.*

Table 4. Summary of Codes and Themes

Themes	Description	No. of Codes
Learning experiences	Learning and navigating the features of Rexy	84
Adjustments	Strategies adopted users to the limitations of Rexy	12
Insights gained	attitudes of users after engaging with Rexy	51
Suggestions for further improvement	recommendations of users to further improve Rexy	21

To clarify further, Anya described the use of Rexy in the following words,

> *It is useful as a learning tool because, as a student, Rexy provides many benefits. The first I can say is its availability. As a student, we are learning many subjects and not oftentimes that the learning takes place in classroom or there is face-to-face learning. So, what is Nice about Rexy is that even though we are at home, it is accessible and available 24/7.*

Michelle also shared that she could even read topics on pharmacology through Rexy while on her way to the university on board a public transport vehicle.

The experience of navigating the chatbot has prompted its users to see its features. Raquel said that inquiring about the terms brings out the definition automatically. Follow-up information is likewise available at the click of a button. (*What I like the most is the automatic response, and there are other features like there is a follow-up information if you want to look for other information related to the topic.).*

Likewise, Judy shared that she learned from Rexy the medication for seizures and the category of caffeine as a stimulant. The design of Rexy has made its users realize that it can be a good prompt for reviewing lessons in pharmacology. Jake and Judy mentioned that the embedded quizzes at a click of a button at the end of every category are helpful in assessing their understanding.

Compared to instructional modules, which Judy described as overwhelming, Rexy has structured its contents, allowing users to focus on a specific topic.

The findings of this study are consistent with the research conducted by Han et al. [9] which highlights the practicality of utilizing AI chatbots to enhance EFM nursing skills among nursing students. The study also recognizes the role of chatbots as facilitators of self-directed learning. Similarly, the studies conducted by Chang, Hwang, and Gau [10]and Chen et al. [11] align with these findings by emphasizing the user-friendly

interface of chatbots and their positive impact on learning engagement. In addition, the flexible availability of chatbots enables students to access learning resources anytime and anywhere, enhancing their overall learning experience. These studies collectively support the notion that chatbots offer valuable benefits in promoting effective and engaging learning experiences for students.

3.4 Adjustments to Address the Challenges in Accessing Rexy

Two issues were seen as a challenge in the use of Rexy. First, it can be overwhelming for first–time users, and second, limitations dictated by mobile internet connection. However, users found ways to address them. At first, Regina found it difficult to navigate the read and backread buttons of going over the topics presented by Rexy.

Those who found Rexy overwhelming during initial use have learned to navigate the buttons and learn its operations intuitively. Two interviewees shared similar experiences on the issues: "*I just explored and read, then I discovered how Rexy works/behaves" (*Regina*); "If you learn how to use Rexy, it will go smoothly* (Coreen).

As regards the non-display of images during the offline mode, users like Michelle viewed the images at home where the WIFI internet connection is available *(When I go home, I would go back to Rexy and view the pictures I have not seen offline* - Michelle).

Indeed, Bdair [12] supports the notion that students in today's generation are technologically savvy. These students exhibit a natural ability to quickly grasp and learn new technologies, effortlessly understanding the functionalities and features of various software and devices. Their proficiency in technology often allows them to navigate tools like chatbots, such as Rexy, intuitively without requiring extensive instructions or guidance. Moreover, Dziuban et al. [13] further emphasize the resourcefulness of tech-savvy students. They have a knack for finding solutions to challenges they encounter, leveraging their technological skills and knowledge. This resourcefulness enables them to overcome obstacles and effectively utilize tools like chatbots to enhance their learning experiences. Considering the technological proficiency and resourcefulness of tech-savvy students, it is not surprising that they can readily adapt to and navigate chatbot systems like Rexy. Their intuitive understanding of technology and ability to find solutions contribute to their successful utilization of chatbots as valuable learning tools.

3.5. Insights Gained While Using Rexy, the Chatbot

3.5.1 *Positive Attitude on Rexy as a teaching and learning tool*: Overall, users of Rexy have shared a positive attitude towards chatbots as a teaching and learning tool. Sarah shared,

> *"Our classmates and I were amazed since we are not aware that chatbots can be used as a learning tool. We were intrigued to use it despite our busy schedule. We'd like to allot time since we'd like to know how to use it. Since its use is like any business, like what's on your menu? Rexy seemed not to be running out of information. So for me, it's really helpful to students."*

The findings of this study align with the research conducted by Kohnke [14] indicates that student users perceive chatbots as valuable supplementary tools that generate interest and engagement in the learning process. This highlights the positive impact of chatbots on student motivation and overall learning experience. Chen et al. [15] further support these findings by highlighting that student are willing to provide recommendations for chatbots as effective learning tools. This demonstrates the recognition among students that chatbots have the potential to enhance their learning outcomes and contribute positively to their educational journey. These studies collectively reinforce the notion that chatbots offer valuable benefits in supporting student learning and engagement.

Some users also concluded that Rexy could be a supplement for in-person teaching. Cristy opined that her use of Rexy had shown her that pharmacology is one course that can be delivered through chatbots because she had learned a lot. It was tested when a regular teacher had yet to be assigned to handle the Pharmacology course at the beginning of the semester, and students had to rely on Rexy to learn about the contents of the course (Anya). Furthermore, Raquel stated that the time allotment for an explanation about medication could be lessened, and students could refer to Rexy. However, some courses would also require in-person interaction between teachers and students. According to Anya, a course on Anatomy is one such course.

This study's findings align with the research conducted by Yin et al. [16] which indicates that students perceive themselves as competent learners capable of independent learning within a chatbot-based learning environment. This suggests that using chatbots reduces the need for continuous face-to-face delivery of instruction, as students feel confident and capable of learning autonomously. Similarly, the study by Essel et al. [17] supports these results by suggesting that positive student responses to chatbots can potentially limit the face-to-face interaction required between academic staff and students. This implies that chatbots can serve as effective tools for facilitating communication and information exchange, reducing the reliance on traditional face-to-face interactions.

3.5.2 Utilization Hinges on Privileges

Users were also cognizant of the privileges attached to the use of chatbots as tools for teaching and learning. Rexy is available offline, which users find an excellent feature. *("Just open the chatbot, and the conversations with Rexy are there."- Cristy).* However, they could only view the images with mobile internet data credits, which reduced the overall experience. They all agree that internet access defines the overall efficiency of Rexy, as observed by interviewees. Users with a readily available internet connection, whether mobile internet or home wifi, would have maximum use of Rexy (Sarah). Contrary to this, Coco reported that the internet connection was the only problem she had accessing Rexy. Finally, Felice summarized, *"[W]e are in a country where there is poor signal. Even the wifi would sometimes fluctuate. That is one of the difficulties or weaknesses in using the chatbot.*"

The findings of this study align with the research conducted by Wallace et al. [18] which highlight connectivity issues as a significant challenge faced by students when using online learning platforms like chatbots. Many students reported needing better internet connections, which can hinder their access to online resources and participation in virtual learning activities. Furthermore, the issue of inadequate network connectivity is particularly pronounced in developing countries, as emphasized by the study [19]

3.6 Suggestions to Further Improve Rexy, the Chatbot

When asked about the further improvement of Rexy, users' suggestions can be categorized into the following: expansion of content coverage, sequencing of the information, and embedding of detailed visual supports.

3.6.1 Expansion of content coverage

Users suggested expanding the contents of Rexy beyond Pharmacology and the central nervous system and covering other topics. For instance, Felice said, *"Rexy should have a wider range of topics".* Jolene suggested, "*If you ask for additional information about the topic, the discussion should not be limited to basic answer*s". Raquel wanted a comprehensive discussion of the topics. The study conducted by Tamrakar et al. [20] classifies chatbots into two categories: open domain and closed domain. In the case of the chatbot Rexy, it is designed as a closed-domain chatbot. As a closed-domain chatbot, users may have suggestions for expanding the content coverage of the chatbot. This finding is consistent with the research by Hew et al. [19] that students expect to receive a wider range of responses from the chatbot. They recommend incorporating richer content into the chatbot as an improvement. The concurrent results from these studies highlight the users' desire for more diverse and comprehensive information from the chatbot. Users expect the chatbot, like Rexy, to provide broader coverage of topics and responses to cater to their needs and inquiries.

3.6.2 Sequencing of the Information

The users of Rexy also found the sequence of information cluttered and *suggested* several ways to address them. Cristy observed that topics and subtopics covered in the chatbot could be organized better to avoid confusion. Coco commented, *"I think the sequencing because, for me, this is when the data slows down. Clicking the "Read More" piles up on previous information.* She suggested hiding previous inquiries *("For it not to pile up. maybe after clicking the Read More – it hides it after.").* Along with this observation, Regina suggested enhancing the placement of buttons for backreading and jumping to other categories *(Enhance the buttons. I had difficulty going back to the category.)*

The findings of this study are consistent with the research conducted by Abd-Alrazaq et al. [21] and Dhinagaran et al. [22] indicating that some participants found room for improvement in the design of the chatbot, despite many participants reporting user-friendly navigation with Chatbot Rexy. This suggests that while the chatbot's navigation is generally well-received, there are areas where enhancements or modifications could be made to further improve the user experience. Similarly, Beilharz and Sukunesan [23] suggest that a button-based navigation system could be a viable alternative, or even preferred, over free-text interaction. This implies that providing users with predefined options and clickable buttons for navigation may offer a simpler and more intuitive user experience compared to relying solely on free-text input.

3.6.3 Embedding of detailed visual supports.

Rexy has images to help explain the information. However, users wanted detailed images. Cristy recommended to use of images appropriate for college students. Judy contended that providing detailed images would help them picture the kind of drug presented by Rexy. For Gretchen, using voice or video can further improve their experience with the chatbot.

Sarah took a step further by suggesting that Rexy could have lesser texts and more animations. She suggested that:

> *It seems satisfying if there is animation. Because with other chatbots, they only use narratives or just texts. I was amazed that there were images. So, as a visual learner, it seems better if it is not bombarded with texts and has images or animations.*

In the context of chatbot design, incorporating visual elements and providing images within the chat can enhance students' understanding and engagement. By including visual representations of concepts and explaining their meaning, the chatbot can provide a multi-modal learning experience that caters to different learning preferences and enhances comprehension. Gupta et al. [24] emphasized the importance of visual representations of concepts for students. Students reported that having visual aids, such as images, helps them understand and comprehend information differently and effectively.

3.7. Integration

Significant score gains reflected in Table 3 aligned with themes of self-directed learning (3.3) and 24/7 accessibility (3.3). However, connectivity barriers (3.5.2) moderated outcomes, explaining score disparities (SD=3.11).

4 CONCLUSIONS

Exploring the experiences of the nursing education community with a pedagogical PCA named Rexy in learning and teaching undergraduate nursing pharmacology subject is the primary goal of this research. Overall, participants perceived Rexy as a practical and valuable tool for enhancing their learning in pharmacology courses. The PCA's user-friendly navigation was widely appreciated, enabling students to interact with it effortlessly. The study also revealed that participants found Rexy to be a facilitator of self-directed learning, allowing them to learn independently and at their own pace.

In addition, students expressed the need for expanded content coverage within the chatbot. They desired a more comprehensive range of responses and richer information to cater to their diverse learning styles. To enhance the PCA's design, suggestions were made for improvements, including a button-based navigation system and incorporating visual elements to support concept comprehension. Moreover, connectivity issues emerged

as a challenge, particularly concerning poor internet connection and inadequate network infrastructure, affecting participants access to online learning platforms, including the PCA. This highlights the importance of addressing these technological barriers to ensure equitable access to educational resources.

Overall, the study emphasizes the potential benefits of chatbot technology, such as Rexy, in supporting student learning experiences. It underscores the importance of user-friendly interfaces, expanded content coverage, and consideration of different learning modalities to create more effective and engaging learning environments for students. Future research and development in this area can further explore and optimize the use of pedagogical conversational agent to meet the evolving needs of students in the digital age.

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