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Original Article

Using Cloud-Based Chatbot Builder in Developing Pedagogical Conversational Agent

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Abstract *- Pedagogical conversational agents (PCAs) are intelligent software agents designed to enhance learning experiences through interactive and personalized instruction. This research aimed to develop a PCA that supports nursing students in acquiring knowledge in a nursing pharmacology course. The study utilized a cloud-based chatbot builder Chatfuel to build the PCA following the chatbot lifecycle. Quality evaluation based on ISO 25010 standards was conducted to assess the developed PCA's compliance and usability. The findings demonstrated that the PCA meets the quality standards and is perceived as a handy tool for learning pharmacology by nursing students. Hence, higher education institutions can recommend using a cloud-based chatbot builder in developing PCA according to their specialization and courses handled. This research contributes to the limited literature on PCA in nursing education and explores the application of cloud-based chatbot builders in developing PCAs.*

Keywords *- Chatbot, Chatfuel, Nursing education, Pedagogical Conversational Agent, Usability testing.*

1. Introduction

Artificial intelligence breakthroughs have resulted in the developing of sophisticated conversational agents known as chatbots. According to [1], chatbots employ AI and natural language processing (NLP) to analyze client questions and automate responses, mimicking human conversation. The use of chatbots has revolutionized customer engagement in various industries [2], including healthcare, specifically for patient counselling [3].

In the academic setting, chatbots are recognized as pedagogical conversational agents (PCAs) due to their ability to fulfill diverse pedagogical roles, such as providing support, assistance, and mentorship [4]. They offer promising and enhanced learning opportunities for learners and management systems [5] [6]. Additionally, they can ensure equitable and inclusive access to education, promote collaborative and personalized learning, and assist in assessment [7]. For example, KNUSTbot [8] improved academic performance in multimedia programming courses and provided more opportunities for interaction between academic staff and students.

PCAs have become increasingly popular in education due to their potential benefits. Students perceive pedagogical agents as safe and convenient for online communication, offering the advantage of round-the-clock availability [9]. By leveraging AI, these agents can efficiently address repetitive and frequently asked questions while providing access to relevant learning materials as needed [10]. They serve as valuable aids for students in refreshing their memory, aiding recall, revision, and retention of acquired knowledge. Furthermore, PCAs facilitate immediate feedback during the learning process through interactive conversations and offer personalized content. This aspect is particularly beneficial for individuals facing constraints such as limited access to instructors due to cost, staff availability, and the challenges posed by the COVID-19 pandemic [11]. Despite the growing popularity of PCAs, their application in nursing education remains limited [12], [13].

The availability of chatbot builders, which are software tools specifically designed to create chatbots without the need for coding skills, has made it possible for even non-computer-savvy teachers to develop their PCAs quickly and efficiently [14]. These platforms offer pre-built solutions and predefined scenarios that simplify the chatbot development process, making it accessible to individuals with limited coding experience without relying on the expertise of software developers [15]. The gap in the literature regarding the use of conversational agents for instructional purposes in nursing education is a pressing issue that needs to be addressed. While the advantages of PCAs as effective instructional tools are recognized, more research is needed to explore the potential of user-friendly chatbot builder

platforms for developing PCAs in nursing education. By developing a PCA using Chatfuel, this study aims to bridge this gap and assist nursing students in a state university by enhancing their learning experience in undergraduate nursing pharmacology courses.

This study also invites instructors to investigate the possibility of user-friendly chatbot builder platforms for constructing their own PCAs. This study seeks to give guidance to educators interested in constructing their PCAs by outlining the PCA development process using the chatbot lifecycle framework proposed by [16]. Furthermore, highlighting the development process of the PCA following the chatbot lifecycle framework proposed by [16], this study aims to provide a guide for educators interested in creating their PCAs.

Lastly, the evaluation of the pedagogical agent according to ISO 25010 Quality Standard is presented, which emphasizes the need for rigorous evaluation of PCAs to ensure their effectiveness and quality as instructional tools. By emphasizing the gap in the literature and the need to conduct this study, this research contributes to the growing body of knowledge on the use of PCAs in nursing education. It provides a basis for further research in this area.

2. Related Literature

Chatbot builders have gained popularity in various industries due to their conversational flow, machine-learning capabilities, and utilization of APIs. These tools allow individuals without extensive programming knowledge to easily create and deploy chatbots. Chatbot builders have seamlessly integrated with various messaging platforms, enabling users to deploy their chatbots directly on the preferred channels of their target audience, enhancing engagement and convenience [17].

In [18], a variety of cloud-based chatbot builders were identified, catering to different levels of complexity and functionality. These tools range from low-level NLP services that assist in encoding intents and training phrases to comprehensive low-code development platforms covering most steps in the chatbot creation process. Industry giants like Google with Dialogflow, IBM with Watson, and Microsoft with Luis offer such platforms. Additionally, specialized chatbot companies like Chatfuel, FlowXO, Chatterbot, and Landbot.io provide innovative solutions for building chatbots. This diverse range of options allows developers to choose tools that suit their specific needs and requirements in chatbot development.

In various disciplines, chatbot builders have proven effective in creating pedagogical chatbots. For instance, in an English language learning study [19], a chatbot developed using Chatfuel was integrated into social media to provide an easy-to-use platform for learners.

The study found that the chatbot effectively promoted self-directed learning and achieved 100% accuracy in analysis results. In another study [20], researchers developed a virtual assistant chatbot using IBM's Watson Assistant functionalities on the IBM cloud. This chatbot served as a radiation safety training tool for clinical staff involved in cancer treatment. It utilized a layered structure approach to engage with users and provide essential information on radiation safety in radiotherapy, enhancing their expertise within a cancer center or hospital setting. Similarly, in a study focused on language learning [21], a chatbot developed using Google Dialogflow facilitated active language learning outside of class to augment classroom training. The chatbot was successfully implemented and perceived as useful in language learning.

However, their potential in nursing education, particularly pharmacology instruction, still needs to be explored. Developing a PCA using cloud-based chatbot builders like Chatfuel could be a promising approach to improving pharmacology instruction and enhancing the learning experience of nursing students.

Regarding chatbot quality, assessing the quality of chatbot-based systems is critical to ensuring their success. ISO/IEC 25010 has emerged as a widely adopted standard in software development, defining software systems' quality characteristics and evaluation criteria. The standard identifies eight key quality characteristics relevant to computer systems: functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability[31].

Several research studies have applied ISO/IEC 25010 in evaluating the quality characteristics of chatbot-based systems. For example, UNYSA chatbot-based public relations communication medium [23] for Yogyakarta State University successfully met ISO/IEC 25010 quality standards for functional suitability, performance efficiency, portability, usability, reliability, and maintainability. Similarly, a Web-based Chatbot Request System [24] for Nueva Ecija University of Science and Technology also met the ISO/IEC 25010 characteristics with high overall ratings.

However, some studies have shown room for improvement in chatbot performance, emphasizing the need for metrics that align closely with the unique usability aspects of chatbots. Furthermore, traditional usability metrics might not effectively measure chatbot usability. Therefore, researchers need to consider the unique qualities of chatbots when evaluating their quality characteristics [25]. A proposed framework for measuring chatbot usability was proposed in [26], including task-based usability, everyday usability, and human likeness. Task-based usability refers to how well the chatbot performs the specific tasks it was designed for, while everyday usability involves the quality of the chatbot's interactions with users.

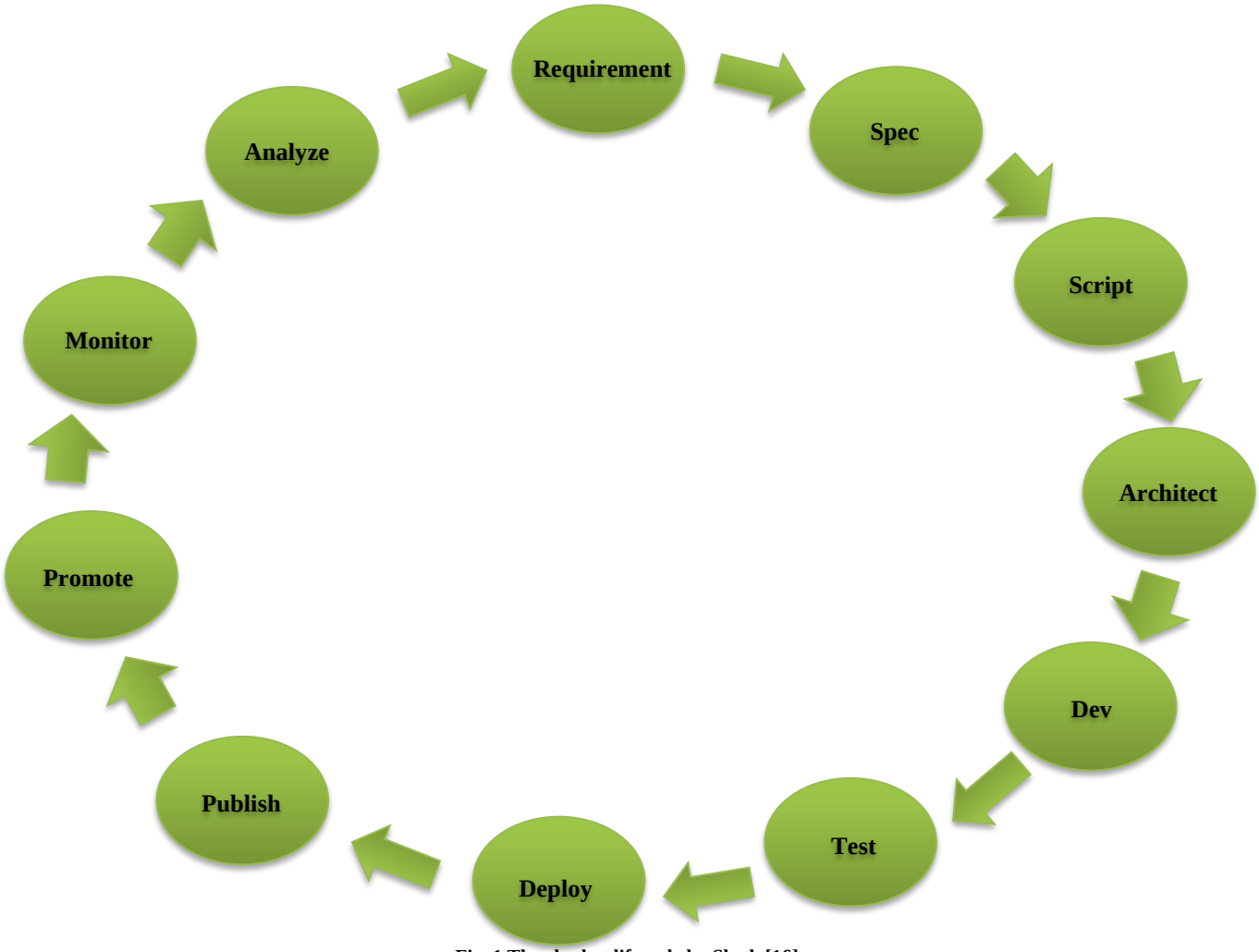

Fig. 1 The chatbot lifecycle by Sheth [16]

3. Methodology

3.1. PCA Development

The chatbot lifecycle proposed by [16], as shown in Fig. 1, was utilized as a framework for developing the PCA for the nursing pharmacology course.

The chatbot lifecycle has 11 phases:

(1) requirement, (2) spec, (3) script, (4) architect, (5) dev, (6) test, (7) deploy, (8) publish, (9) monitor, (10) promote, and (11) analyze.

3.2. Evaluation

3.2.1. Quality

To ensure quality, the developed PCA was subjected to a quality assessment prior to its deployment. Five experts in software development and machine learning evaluated the PCA's quality based on selected ISO 25010 characteristics: functional suitability, performance efficiency, reliability, maintainability, and portability. The blackbox testing technique was employed in this process.

Each evaluated feature received a value of 1 if the expected result was visible and a value of 0 otherwise. The scores for each item were calculated using the following formula:

$$X = \frac{I}{P} * 100 \quad (1)$$

Where I denotes the number of features that were visible when implemented, and P refers to the total number of features.

3.2.2. Usability

Following its deployment, the PCA underwent a usability evaluation. A total of 41 nursing students in a state university in Western Visayas, Philippines, were purposefully selected to participate in the evaluation. The Chatbot Usability Questionnaire (CUQ) developed by [26] with 16 items was utilized to assess PCA's usability. The overall CUQ score was determined on a scale of 0-100, with a higher score indicating higher perceived usability.

3.3. Scales

The following scales were utilized to interpret the blackbox testing and chatbot usability questionnaire results.

Score (%)	Interpretation
95.1 - 100	Excellent
75.1 - 95	Good
50.1 – 75	Average
25.1 – 50	Poor
0 – 25	Very Poor

4. Results and Discussion

4.1. PCA Development

The 11-phase chatbot lifecycle was utilized to develop the pedagogical conversational agent. The following activities were undertaken as part of the development process.

4.1.1. Requirement Gathering and Analysis

This is the first step of the chatbot-building process, which involves needs assessment and data collection. The result of the needs assessment determines the functional requirements of the PCA. The data collection was comprised of the following: interviews with the faculty, students, and content expert; material analysis of the course syllabus and learning materials; the literature of the published articles relating to PCAs; and observation of the end-users' learning activities. Table 1 enumerates the functional requirements of the PCA in this phase.

Table 1. Functional requirement of the pedagogical conversational agent

No	Functional Requirement
1	Include greetings.
2	Define capabilities and limitations.
3	Include checking for understanding.
4	Employ feedback depending on the correctness of the answer.
5	Can discuss central nervous system (CNS) drugs, including stimulants, depressants, antiseizure, anti-parkinson's medication, and anti-alzheimer's drugs.
6	Can discuss side effects and contraindications of CNS drugs.
7	Can enumerate the nursing process in drug administration.
8	Can provide external links for further explanation or elaboration.
10	Integrate Persistent Menu for most accessed options.
11	Provide a brief description of the PCA.
12	Enumerate the references.
13	Provide tips to achieve optimization of the conversation.
14	Set user expectations.

4.1.2. Specification Identification

The functional requirements identified in the first step were improved to define the overall design of the PCA. These improvements were elicited from the study of literature. Table 2 enumerates the PCA's specifications and deliverables.

Table 2. Specifications of the pedagogical conversational agent

Specification	Deliverables
Objective	To create a chatbot that can assist learning in NCM 106 Pharmacology
Target User	Nursing students, nurses, nursing faculty
Type	Text-based, rule-based
Contents	(See Table 1 for functional requirements)
Name	Rexy (inspired by the two letters (Rx) usually appears on the prescription pad)
Personality	Professional, kind, honest
Tone and Language	Friendly, polite, encouraging, and light-hearted.
Human Involvement	Partly
Delivery Channel	Facebook Messenger

4.1.3. Designing Conversation Flow

This is a unique step of the chatbot-building process because it is not conducted in a traditional software development process. A conversation was written that guides the user towards accomplishing a desired task and represents user interactions. The conversation flow entails a script of the actual conversation of the PCA based on the user intent. The content expert validated the script as to the accuracy of the contents, and the language expert checked the tone and personality defined in the specifications. Fig. 2 shows one of the conversation flows.

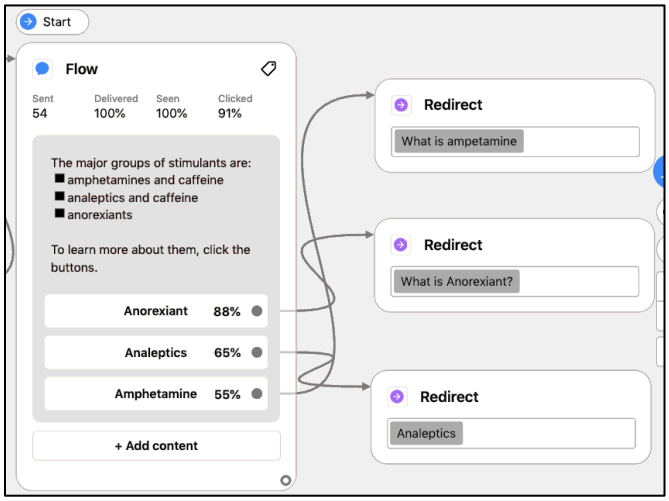

Fig. 2 Example of conversation flows

4.1.4. Architecture and Developing

Chatfuel was utilized as the platform for developing the PCA. Chatfuel is an excellent cloud-based chatbot-building platform that provides users with a user-friendly interface for creating chatbots [27]. A Facebook Page (FB) account was created to access the Chatfuel dashboard. The FB account serves as the starting point for users to interact with the PCA via messaging.

The conversation flow, designed in the previous stage, was implemented using the "flows" and "blocks" elements provided by Chatfuel. Flows represent different conversation scenarios between the user and the PCA, while blocks consist of individual messages or configured chatbot actions, such as greeting messages or email collection prompts [28].

Throughout the development of the PCA, rigorous unit testing was conducted using the emulator to ensure that the flows operated as intended and aligned with the desired design.

4.1.5. Testing

Following the integration of the conversation flows into the chatbot builder, beta-testing was conducted with a group of 10 participants. This group included a content expert, a language expert, two IT experts, and five nursing students. The primary objective of the beta-testing was to assess whether the PCA functioned without any technical errors, such as broken conversation flows, and to ensure that the tone of the PCA aligned with its intended persona.

The participants were also asked to evaluate whether the PCA's visual design and overall user experience matched its intended goals. After interacting with the PCA, the participants provided their reports, sharing their observations and suggestions for improving the PCA. The most frequently reported errors during the beta-testing phase were related to incorrect spelling. A suggestion was also made to include an additional navigation technique allowing users to revisit topics. These identified errors were promptly corrected, and the suggested improvements were implemented accordingly.

In addition, to assess the quality of the developed PCA, a panel of five IT experts conducted an evaluation based on the ISO/IEC 25010 standards. The valuable suggestions provided by the experts were carefully considered and implemented to enhance the functionality and overall performance of the agent.

By addressing the reported errors and incorporating the participants' suggestions, the PCA underwent iterative refinements to enhance its functionality, user experience, and overall performance.

4.1.6. Deployment and Publishing

The PCA was deemed ready for deployment and publication after thorough testing and validation. It was seamlessly integrated with a Facebook Page account, allowing it to host conversations with users, as shown in Fig. 3. Facebook and FB Messenger were selected as the preferred platforms for deploying and publishing the PCA. During interviews, it was observed that most nursing students expressed a strong affinity towards Facebook as their preferred social media platform, with FB Messenger as their preferred communication software. Hence, choosing Facebook and FB Messenger as the deployment platforms aligned well with the students' preferences and ensured widespread accessibility and engagement.

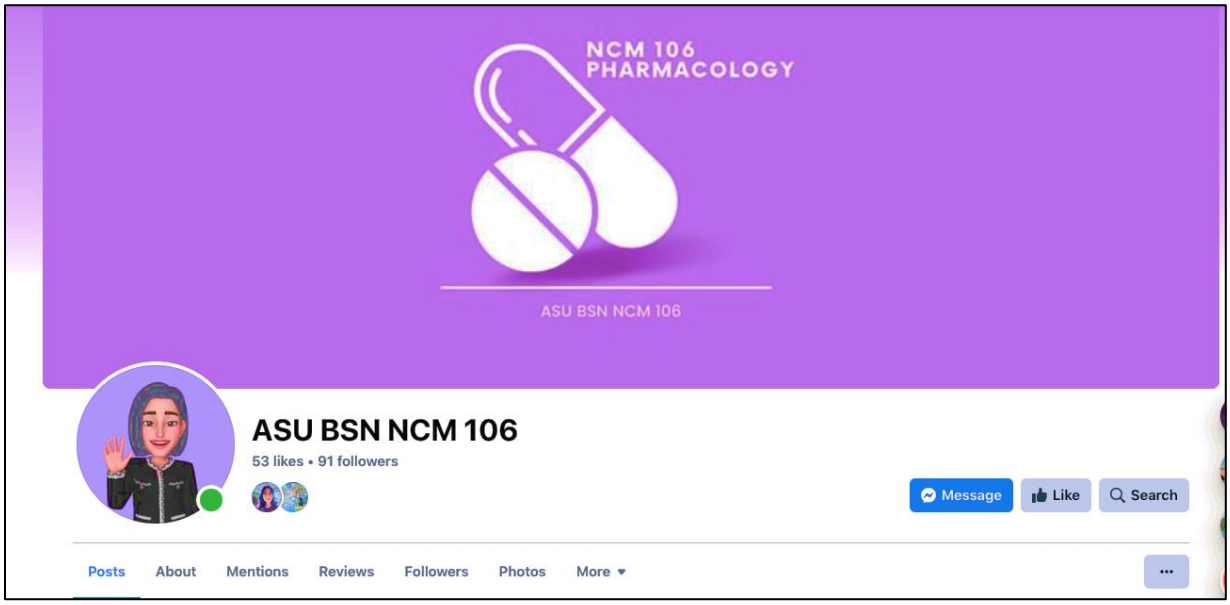

Fig. 3 The facebook page of the PCA

4.1.7. Promotion

The PCA is discoverable on Facebook and FB messenger using the keyword "ASU BSN NCM 106."

4.1.8. Monitoring

The PCA was monitored for any unanswered inputs or if it became unresponsive. Usually, this was done by monitoring the user conversation by logging in on FB messenger using the FB page account.

4.1.9. Analysis

Chatfuel provides the capability for analysis through the 'Analyze' menu. This analysis enables gathering insights regarding various aspects of the PCA's performance, including the number of users, the most frequently utilized buttons, and the popularity of specific blocks within the PCA. Additionally, the performance of the PCA Flows is examined using metrics and indicators. Consequently, optimizing the conversational flows for the best user experience is possible.

4.2. Interfaces

Fig. 4-9 shows the interfaces of the pedagogical conversational agent.

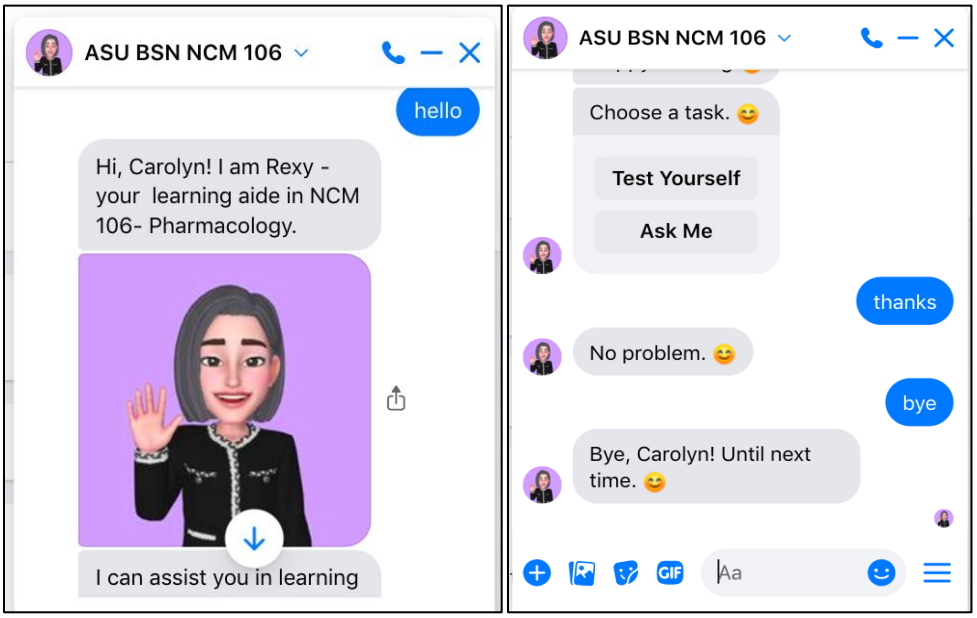

Fig. 4 PCA's greetings

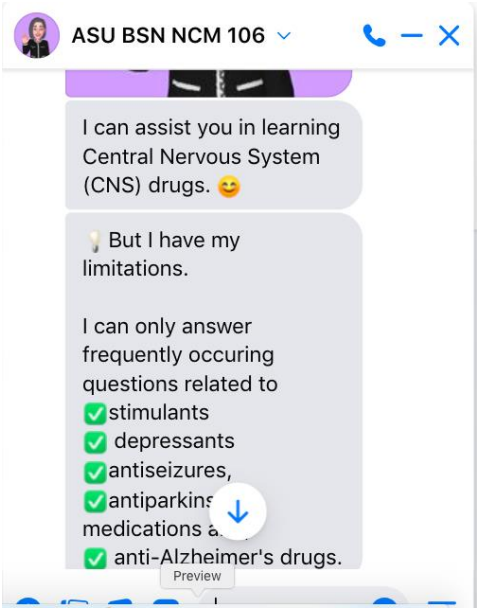

Fig. 5 PCA's capabilities and limitations

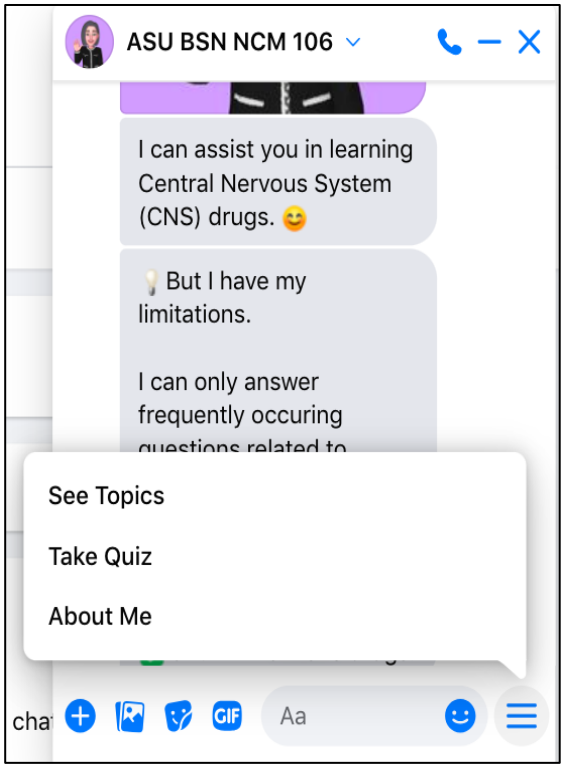

Fig. 6 The persistent menu for friendlier navigation

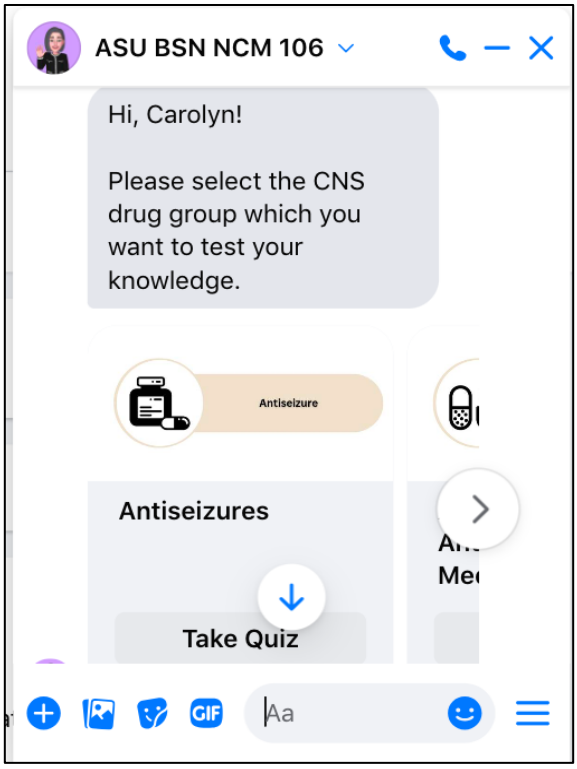

Fig. 7 Provides checking understanding feature

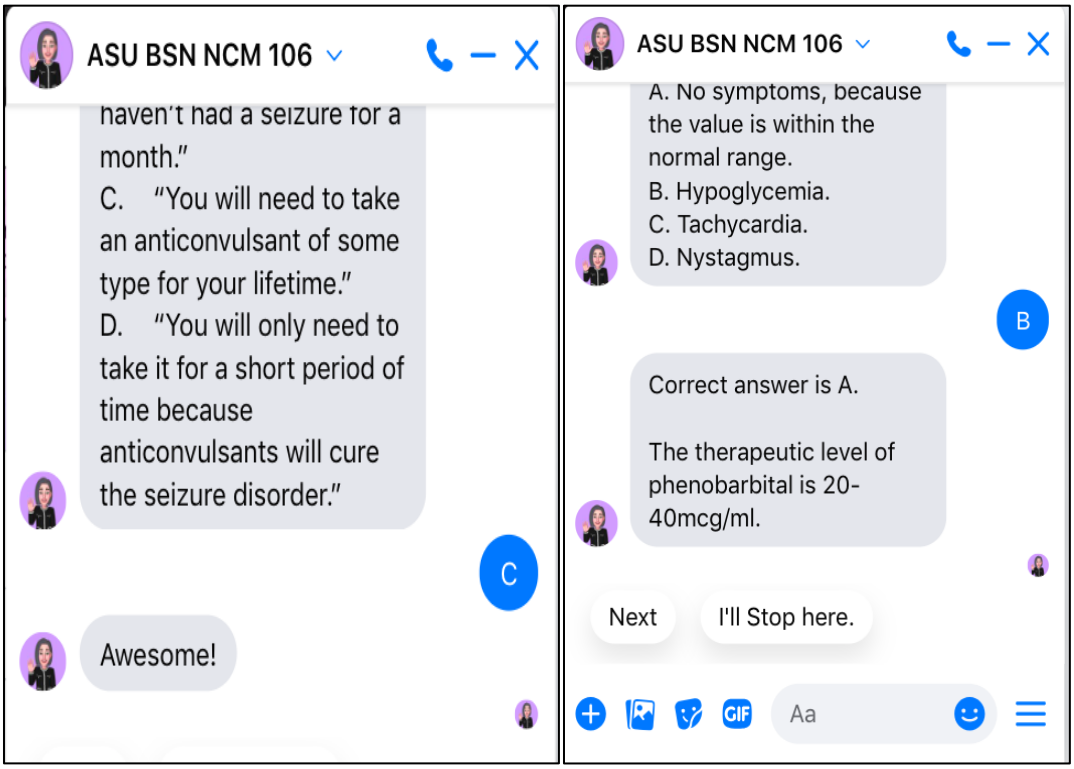

Fig. 8 Providing feedback

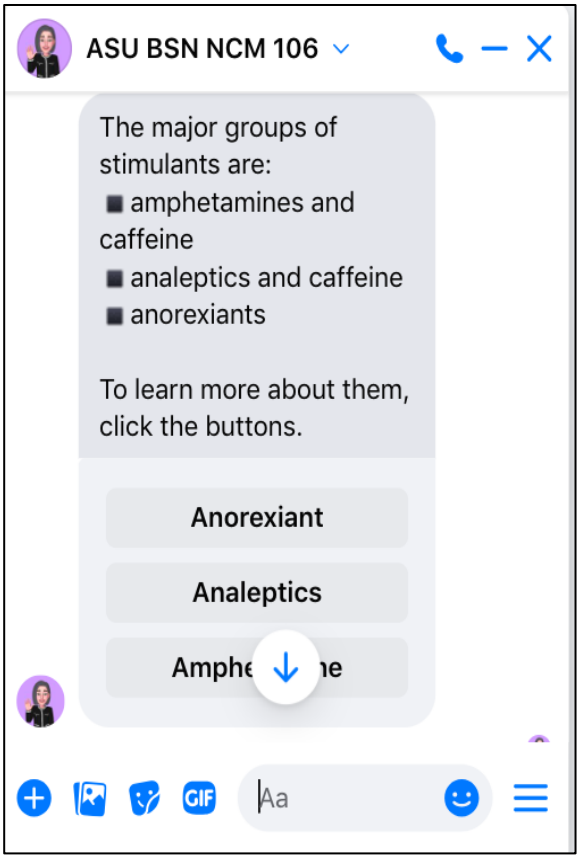

Fig. 9 Providing topics discussion

4.3. Quality

To assess the quality of the PCA, an evaluation was conducted using the blackbox method and a checklist to test the system's adherence to international standards. The blackbox method is a testing approach where the tester is aware of the expected input and output based on requirements specifications [31]. This is similar to the work of [29]. This method was employed to evaluate specific attributes outlined in the ISO 25010 standard, including functional suitability, performance efficiency, reliability, portability, and maintainability.

4.3.1. Functional Suitability

Table 3 shows that the PCA's quality, particularly in terms of functional suitability, was Excellent and aligned with the requirements outlined in this aspect. Furthermore, this result confirmed that the individual feature of the PCA performs adequately according to its intended design and purpose.

4.3.2. Performance Efficiency

Table 4 shows the performance efficiency of the PCA. Results demonstrated that the PCA was Excellent in terms of performance efficiency and that it can respond in real-time with the given inputs even if network conditions are not good.

4.3.3. Reliability

The chatbot's reliability criteria comprise maturity, availability, fault tolerance, and recoverability. Table 6 shows the result of the evaluation of IT Experts on Reliability.

Table 3. Functional suitability evaluation results

Tested Features	Expected Results	Results
Greetings	The PCA can greet and set user expectations regarding its capabilities and limitations.	Excellent
Ask Me	The PCA provides correct answers to queries within the scope and limitations of the chatbot.	Excellent
Test Yourself	Users can check their understanding of the topic. Feedback on wrong answers is also provided.	Excellent
See Topics	The PCA provides a list of options of topics for discussion where users can learn in a non-linear manner.	Excellent
Persistent Menu	The PCA provides easy access to the most frequently used features.	Excellent
Read More buttons	The PCA provides further discussion of the topic chosen.	Excellent
Quick Replies option	Quick Replies buttons such as 'Yes,' and 'No' are working appropriately.	Excellent
Pictures	Pictures are clear and appear quickly.	Excellent
External Links	External links to websites are available.	Excellent
References	PCA's discussions are based on reliable materials.	Excellent
How to Ask Me	PCA provides tips for the optimization of the conversation.	Excellent
What Can I Do	PCA orients users as to its capabilities and limitations.	Excellent

Table 4. Performance efficiency evaluation results

Aspect	Evaluation	Expected Results	Results
Time Behavior	The ability of the PCA to provide an appropriate response quickly when performing its functions.	The PCA can work quickly by responding in real-time with the given inputs.	Excellent
Resource Utilization	The ability of the PCA to use its resources when performing specified functions.	The PCA can work under a 1 Mbps network which means the PCA can work even though the network conditions are not good.	Excellent

Table 5. Reliability evaluation results

Aspect	Evaluation	Expected Results	Validator's Results				
			1	2	3	4	5
Maturity	The ability of the chatbot to operate under normal conditions, such as with stable connectivity and correct inputs.	The chatbot can respond efficiently, given stable connectivity and correct inputs.	1	1	1	1	1
Fault-Tolerant	The ability of the chatbot to operate as intended despite the presence of errors such as loss of connectivity and incorrect inputs.	If an error occurs due to loss of connectivity, the FB messenger application can notify users of no connectivity. However, if incorrect input was entered, the users were notified to review their inputs.	1	1	1	1	1
Recoverability	The ability of the chatbot to rebuild performance levels in the event of system error, such absence of internet connectivity.	If an error occurs due to loss of Internet connection, the chatbot can immediately respond when the Internet connection resumes.	1	1	1	1	1
Availability	The ability of the chatbot to be accessible when it is needed to be used.	The chatbot is available 24/7 as long as the user has an Internet connection.	1	1	1	1	1
		Total Score	4	4	4	4	4
		Percentage	100%	100%	100%	100%	100%

Based on the result, the PCA is excellent in terms of reliability as it can respond efficiently given the correct inputs and a stable internet connection. It can notify users of loss of connectivity and wrong inputs and respond immediately once the connectivity resumes. Lastly, the PCA has high availability, that users can access it 24/7.

In UNYSA [23] and web-based chatbot request systems [24] showed the same results, with their systems rated as "highly feasible" and "highly reliable," respectively.

4.3.4. Maintainability

Maintainability testing was performed in terms of modularity, reusability, analyzability, and modifiability by accessing Chatfuel's dashboard.

Table 6 shows the result of the testing on maintainability. Based on the results, the PCA is Excellent. The agent can handle more conversation flows without affecting the existing flows or by reusing the existing ones to create new ones without degrading the current quality. It means that PCA can handle more topics aside from central nervous system drugs. In addition, the PCA can diagnose deficiencies or failures through its built-in emulator, which allows the creator to check whether the conversation flows work as designed.

4.3.5. Portability

IT experts performed portability testing by accessing the PCA on different operating system platforms and mobile devices via the FB messenger app or browsers.

Table 6. Maintainability evaluation results

Aspect	Evaluation	Expected Results	Results
Modularity	The ability of the PCA to be modified without affecting the other components.	The PCA more conversation flows without affecting the existing conversation flows.	Excellent
Reusability	The ability of the PCA's components to be used in building another chatbot.	The PCA's existing flows and blocks can be reused to create other conversation flows.	Excellent
Analyzability	The ability of the PCA to provide a diagnostic facility.	The PCA has a built-in emulator for unit testing to check whether conversation flows work as designed.	Excellent
Modifiability	The PCA's ability to be modified without introducing defects or degrading existing quality.	The PCA's existing conversation flow can be changed without degrading the existing quality.	Excellent

Table 7. Portability evaluation results

Aspect	Evaluation	Expected Results	Results
Adaptability	The PCA can function effectively and efficiently regardless of the operating system and browser.	The PCA can function on personal computers, Mac computers, or mobile devices. It can also function using a browser or directly on Facebook Messenger.	Excellent
Installability	Once deployed, the PCA can be operational 24/7. It can also be deleted anytime to make it inaccessible.	The PCA can be accessed anytime and anywhere, given the user has connectivity. The PCA can be deactivated anytime, if necessary.	Excellent
Replaceability	It is the ability of the PCA that can adapt to another social media platform.	The PCA can also be deployed on Instagram.	Excellent

Table 7 shows the results of testing on portability. The PCA adapts to different hardware, software, or other operational specifications, is available and accessible anytime and anywhere, and can be deactivated anytime, if necessary. Moreover, the PCA can be deployed on Instagram.

4.3.6. Usability

The adopted CUQ [26] was utilized to evaluate the usability of the PCA in learning undergraduate nursing pharmacology courses. It has 16 items that can be divided into eight factors; namely personality (i.e., the extent to which participant perceived that the PCA has its personality; item 1& 2), Onboarding (i.e., setting the tone of interaction; item 3 & 4), purpose (i.e., the clarity of the PCA's goal; item 5 & 6), Navigation (i.e., easiness of carrying the conversational flow; item 7 & 8), Understanding (i.e., how well the PCA recognizes participants' inputs; item 9 & 10), Responses (i.e., the relevance of PCA's responses; item 11 & 12), Error handling (i.e., how the PCA manages and responds to errors that occur during the interaction; item 13 & 14) and Ease of use (i.e., the degree to which the PCA is user-friendly; item 15 & 16).

Tables 8 and 9 categorize the items into positive aspects (i.e., odd numbers) and negative aspects (i.e., even numbers) based on the classification provided by [26]. The cumulative percentage for the highest and lowest level of agreement (i.e., CUQ scores of 11 and 13) was reported. Table 8 reveals that 97.5% of the respondents found the PCA to have the highest quality in terms of providing useful, appropriate, and informative responses. The next best quality reported by respondents is the PCA's realistic and engaging personality, along with its ability to provide clear explanations about its scope and purpose and its user-friendly nature (95.1%). However, 68.3% of the respondents perceived that the PCA did not handle errors or mistakes well.

On the other hand, Table 9 shows that 26.9% of the respondents felt that the PCA seemed robotic, while none reported that the PCA failed to recognize their inputs.

Table 8. Items showing PCA's positive features

	Mean	Agree/ Strongly Agree (%)
Personality		
1. The PCA had a realistic and engaging personality.	4.56	95.1
Onboarding		
3. The PCA displayed a welcoming approach during the initial setup.	4.41	85.4
Purpose		
5. The PCA provided a clear explanation of its scope and purpose.	4.46	95.1
Navigation		
7. The PCA was simple to navigate.	4.41	90.3
Understanding		
9. The PCA understood me well.	4.04	80.5
Responses		
11. PCA responses were useful, appropriate, and informative.	4.80	97.5
Error handling		
13. The PCA effectively handled any errors or mistakes.	3.76	68.3
Ease of Use		
15. The PCA was simple to use.	4.56	95.1

Table 9. Items showing PCA's negative features

	Mean	Agree/ Strongly Agree (%)
Personality		
2. The PCA appeared to be overly robotic.	2.98	26.9
Onboarding		
4. The PCA seemed very unfriendly.	1.73	4.8
Purpose		
6. The PCA gave no indication as to its purpose.	1.98	4.9
Navigation		
8. It would be easy to get confused when using the PCA	2.17	7.3
Understanding		
10. The PCA failed to recognize a lot of my inputs.	1.93	0
Responses		
12. PCA's responses were irrelevant.	1.66	2.4
Error handling		
14. The PCA appeared to be incapable of dealing with any errors.	2.05	2.4
Ease of Use		
16. The PCA was quite complicated.	2.61	22

The computation of the PCA's usability is displayed in Table 10. Overall, the PCA garnered 78% in terms of usability and was interpreted as "Good". This result was consistent with [25], highlighting that the perceived usability rating of their developed chatbot was 76% and was on a very good scale. The findings suggest that the developed PCA was considered usable and acceptable as a teaching and learning tool in the nursing pharmacology course. This was supported by its high-quality attributes, including the provision of useful, appropriate, and informative responses, a user-friendly interface, and the ability to set learners' expectations by providing information about its scope and purpose. These attributes were emphasized in [30] as significant characteristics to be considered in designing an effective pedagogical conversational agent.

Table 10. PCA's usability score result

Items	Mean
1. The PCA had a realistic and engaging personality.	4.56
2. The PCA appeared to be overly robotic.	2.98
3. The PCA displayed a welcoming approach during the initial setup.	4.41
4. The PCA seemed very unfriendly.	1.73
5. The PCA provided a clear explanation about its scope and purpose.	4.46
6. The PCA gave no indication as to its purpose.	1.98
7. The PCA was simple to navigate.	4.41
8. It would be easy to get confused when using the PCA.	2.17
9. The PCA understood me well.	4.04
10. The PCA failed to recognize a lot of my inputs.	1.93
11. PCA responses were useful, appropriate, and informative.	4.80
12. PCA responses were irrelevant.	1.66
13. The PCA effectively handled any errors or mistakes.	3.76
14. The PCA appeared to be incapable of dealing with any errors.	2.05
15. The PCA was simple to use.	4.56
16. The PCA was quite complicated.	2.61
A. The Sum of Positive Questions (Odd numbered items)	35.02
B. The Sum of Negative Questions (Even numbered items)	17.10
C. A – 8	27.02
D. 40 – B	22.90
E. CUQ Score = [(C + D)/64 x 100]	78.00
Interpretation	**Good**

5. Conclusion and Future Works

This study aimed to develop a pedagogical conversational agent specifically designed for the undergraduate nursing pharmacology course. This system aimed to provide valuable support to the nursing education community, particularly nursing students, in acquiring knowledge in the pharmacology course. To achieve this, the chatbot lifecycle was followed by utilizing Chatfuel, a cloud-based chatbot builder. The developed PCA underwent a comprehensive quality evaluation, and the findings revealed that it adheres to the standards outlined in ISO 25010. Furthermore, the nursing students perceived the pedagogical agent as highly usable for learning pharmacology. As a recommendation for future work, it is suggested to expand the application of the pedagogical agent to different courses. Additionally, it is recommended that teachers, regardless of specialization, should take advantage of the cloud-based chatbot builders in creating their PCAs to provide enhanced learning experiences to their students.

Compliance with Ethical Standards

It was taken into consideration ethical issues while conducting the study, such as informed consent and confidentiality of the results. Furthermore, before the study, the participants were informed that their participation was voluntary, and they were free to withdraw anytime without facing any negative consequences. Additionally, they were informed that they had the option to decline to answer any questions they felt uncomfortable with.

The respondents in the study were asked to sign a letter of consent, which included information about the nature and objectives of the study. The research instruments were administered after the participants' consents were secured.

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