

# iNOUN Chatbot: Providing Support and Microlearning with a Web Based Conversational Smart Assistant

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## Abstract

Innovative solutions based on Artificial Intelligence (AI) are transforming modern society. The goal of AI is to create computers or machines that imitate human abilities as closely as possible. Conversational interfaces, or chatbots, are considered a revolutionary step towards the next generation of digital experiences. Few studies, however, have examined how these tools can be used to increase access to education and content-driven support. This study describes and demonstrates an intelligent support personal bot that responds to simple questions on information on the university website. Furthermore, the chatbot can provide learners with small chunks of learning material via voice and text input. The iNOUN chatbot uses Drupal's content management system to serve content, Google's Dialog flow NLU tools to process text and voice input, and a chatbot interface to interact with users. The web-based system powered by Artificial Intelligence will offer personalized support to learners as well as serve as a teaching assistant capable of presenting small chunks of content to learners. As a result, equity, inclusion, and lifelong learning are likely to be promoted.

## Introduction

Over 1.5 billion children and youth across 192 countries across the globe were impacted by the COVID-19 school closures and mitigation strategies implemented to curb the pandemic (UNESCO, 2020). To make education systems more resilient, innovative approaches are needed. To withstand such catastrophic events, appropriate models, methods, policies, and processes should be conceived, designed and implemented. Open and Distance learning gained central stage during this time due to the advantages it offers for learning at any time and from any location (Clapp et al., 2019; Masalimova et al., 2022). Establishing or scaling up distance learning strategies became important response to the sudden interruptions.

Artificial intelligence (AI) and machine learning are revolutionizing how we study and work today. The term AI refers to the application of computers to perform tasks normally handled by humans such as decision-making, speech recognition, visual perception, learning, pattern recognition, problem-solving, and translation between languages (Nilsson, 2014; Russell & Norvig, 2016). The potential of AI to help cope during disruptive and unusual circumstances has been enumerated (Masalimova et al., 2022). We are gradually integrating technologies like Intelligent Tutoring Systems (ITS), Data Analytics, Internet of Things (IoT), autonomous vehicles, robotics and virtual assistants into our everyday lives (Doering et al., 2008; Okonkwo & Abejide, 2020; Roos, 2018; Yang & Evans, 2019). Education is one of the many sectors where AI has a transformative impact. The education sector is experiencing revolutions due to the creation of new tools, methods of learning, access to knowledge and teacher training (Masalimova et al., 2022).

Large educational institutions like the National Open University of Nigeria have multiple centres throughout the country and a large number of applicants, students and employees. Administrative and academic staff often find it difficult to attend to all queries by emails, text and phone calls because of the sheer volume and insufficient time. Furthermore, some users find it difficult to locate information available on the websites. However, as AI-driven tools and digital assistants gain traction in business and large organizations, there is need to have solid applications in educational institutions as well. This is likely to contribute to building resilience and providing much needed support at scale.

This paper seeks to describe the development of a chatbot named iNOUN designed to provide answers to frequently asked questions by new and prospective students with human-like responses. It also describes how the bot can be used to provide short, focused course content in response to students requests for definitions or explanations. A short usability study to examine the usability of the Bot is then described.

This study adds to the existing literature on Chatbot applications in education in the following ways.

1. It demonstrates how a chatbot can be built using a Natural Language Processing (NLP) engine and a content management system
2. It describes the feasibility and potential benefits of using Chatbot systems for student support and educational purposes.

## Related Works

The introduction of Artificial Intelligence technology enables the integration of Chatbot systems into various aspects of education (Pennachin & Goertzel, 2007). According to Ciechanowski et al., (2019), chatbots are conversational or interactive agents that respond instantly to a user's questions. Increasingly, chatbots are used to improve student interaction in a digital era where communication and many other activities rely heavily on online platforms (Okonkwo & Ade-Ibijola, 2021; Yang & Evans, 2019). The rise of conversational agents has been considered as next big shift in computer interfaces which can be correlated with the significant emergence of the point-and-click interface in the 80s.

Chatbots can instantly provide students with standardized details, such as course contents, , practice questions and answers (Sinha et al., 2020) , provide criteria for selection of items (Benotti et al., 2018; Durall & Kapros, 2020), showing due dates for assignments and providing guidance (Ismail & Ade-Ibijola, 2019), providing directions on campus (Mabunda & Ade-Ibijola, 2019) and study resources. In addition to improving student engagement and support, these systems can radically reduce lecturers' administrative workload, allowing them to devote more time to curriculum development and research (Cunningham-Nelson et al., 2019). A research work on the use of Chatbot for Massive Online Open Course by Ser Ling and Ong Sing (2016), evaluated and developed MOOC-bot based on the infamous Chatterbox Challenge (CBC) and Loebner Prize which showed that it is possible to provide correct answers most of the time during the test and demonstrated the capability to prolong the conversation.

These and other works have inspired the research of this work in order to develop a system that can answer FAQ and related matters concerning admission, tips, course material and relevant issues related to National Open University while also evaluating the User Experience based on ISO 9241:11 expectations.(Lewis, 2006).

Chatbots can also be useful for Microlearning. Microlearning deals with relatively small learning units and short-term learning activities (Corbeil et al., 2021). In e-learning and related fields, it refers to the process of learning via computer mediated environments. In 2019, Badrul Khan described the concept of learning snippets for delivering quick, cost-effective, and meaningful training solutions to organizations for performance improvement (Khan, 2019). He categorized learning snippets into two kinds: (1) informational snippets, learning objects used to deliver quick information to a target audience, and (2) instructional snippets, learning objects used to teach a single concept or skill (Khan, 2019). As with FAQ,s chatbots can be use to respond to learners requests regarding a course content

## Methodology

The iNOUN prototype is a conversational bot designed to overcome the complexity of accessing information and data by providing human-like conversations and responses. The tool is a digital assistant which uses the Google DialogFlow AI engine to respond to a wide range of student inquiries about the National Open University of Nigeria. DialogFlow NLP was chosen for its versatility and rich development environment(Boonstra, 2021; Cahn, 2017). iNOUN transforms the ways prospective and current students can get information and insights that can support their studies or can direct them to how to get resources available on the website without the need to search through tons of web pages or need for human assistance. Generally, the Bot is able to respond to student questions including inquiries from students about the university (for example how to go about registration, semester dates, National Youth Service Corps (NYSC) issues, study centre locations, the application process, and more).

## Technology and Mode of Operation

The digital assistant sits on a Drupal Content Management System (CMS) where it solicits conversational interactions with end-users. Drupal was used in the design because of its high flexibility compared to others (Abbott et al., 2016). An inquirer types text response or speaks to the bot. Google's Dialog Flow Natural Language Processing (Understanding) engine is the brain that interprets and understand the query or question and

then translates it into machine-friendly language. The NLP It also implements the required logic (sending an email, providing a link or booking an appointment) and renders the processed response

## System Architecture

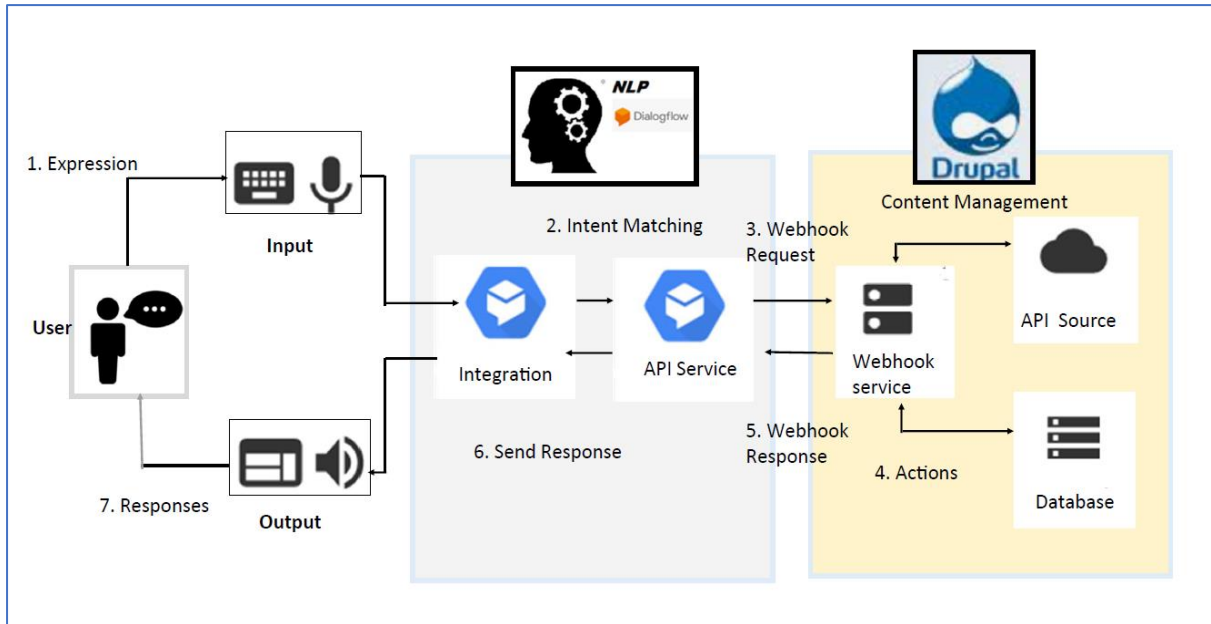


Figure 1. Chatbot System Architecture

A stepwise description of the system is as follows:

1. The user inputs data into the application by using a device. It is possible to enter text or voice messages as input. The message is passed on to Dialogflow NLP engine.
2. Dialogflow categorizes the incoming message and matches it with the defined intents. During the process of developing the intents, training phrases are used to help train the system in intent identification.
3. A request is sent to the webhook service on the Drupal content management system to determine what action needs to be taken for the entry.
4. After using the external API and scanning the database, Dialogflow is again informed of the action to take.
5. Next, the Dialogflow answer will be arranged so that the appropriate answer can be transmitted into the integrated platform.
6. In order to perform the right action in the application or device, formatting is done.
7. The message is then delivered to the end-user.

A screen shot of the FAQ Bot is shown below.

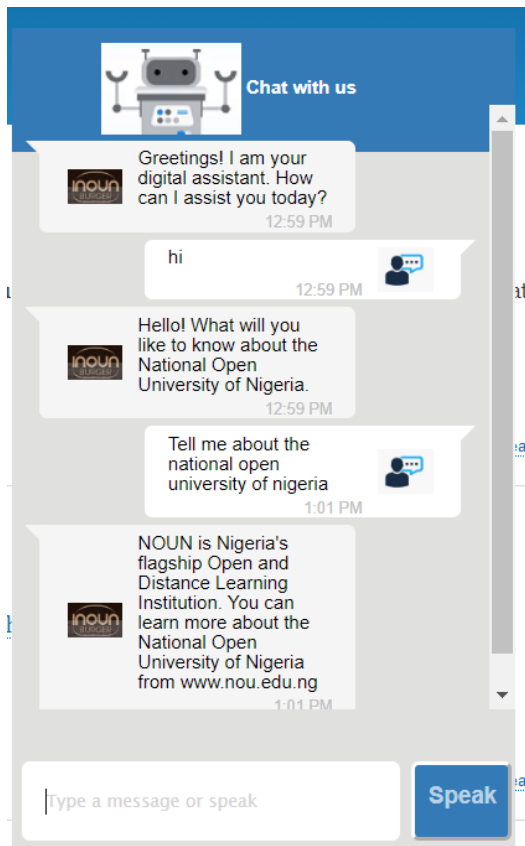


Figure 2 The iNOUN Chatbot

## Usability Evaluation

The following presents the evaluation on the first version of the iNOUN Chatbot conducted to determine the usability of the chatbot. Usability testing focuses on measuring a human-made product's capacity to meet its intended purpose. (Gould & Lewis, 1985; Lewis, 2006) The System Usability Scale (SUS) is a simple scale based on ten-item relying on the Likert scale grading to give a global view of subjective assessments of usability. The "SUS" is one of the best known standardized usability rating scales for usability evaluation. It focuses on providing a lightweight (10 questions) subjective feedback from users testing the system (Salvendy, 2012; Sauro & Kindlund, 2005).

The SUS is a 10 item questionnaire with 5 response options are:

- i. I think that I would like to use this system frequently.
- ii. I found the system unnecessarily complex.
- iii. I thought the system was easy to use.
- iv. I think that I would need the support of a technical person to be able to use this system.
- v. I found the various functions in this system were well integrated.
- vi. I thought there was too much inconsistency in this system.
- vii. I would imagine that most people would learn to use this system very quickly.
- viii. I found the system very cumbersome to use.
- ix. I felt very confident using the system.
- x. I needed to learn a lot of things before I could get going with this system.

These Questions are graded from Strongly Disagree (1) to Strongly Agree (5).

Based on the System Usability Scale (Saura, 2011), the evaluation procedure is as follows;

- **For odd items:** *subtract one from the user response.*
- **For even-numbered items:** *subtract the user responses from 5*

This scales all values from 0 to 4 (with four being the most positive response). The values are added up for the converted responses for each user and then multiplied by 2.5 to give 100. This conversion result into a range of possible values from 0 to 100 instead of from 0 to 40. The average score regarding how usable the system can be is regarded as 67 percentile. Ref 59

### Usability Factor

In System Usability Scale (Jordan et al., 1996), the first Eight Questions of the questionnaire are based on Usability Factor of the designed system for which is used to independently determine Usability of test model with regards to survey response and grading system.

### Learnability Factor

The learnability factor determines how easy it is to learn the new system and indicates where improvement needs to be made in order to make it more usable and how easy it is for first-time users to adapt and understand its capabilities. The last two questions are based on the learnability of the model and graded in combination with the usability factor to arrive at the system usability scale value as a percentile.

## Results

Thirty-eight users tried the system and answered the questionnaire; the analysis was based on the Standard SUS grading for all users' response. Accordingly, Souro, 67 Percentile of the System Usability Scale is considered the cut-off mark as Average, rather 50%. Thus, the responses are collated in percentage, and an average is taken to get the statistical mean of the survey and then evaluated in Percentile.

89.4% of the respondents rated beyond average and considered the system Usability index high enough to represent a Human responder. The iNOUN Chatbot learnable factor is regarded as high as fewer respondents required additional learning in order to be able to interact and respond to the iNOUN.

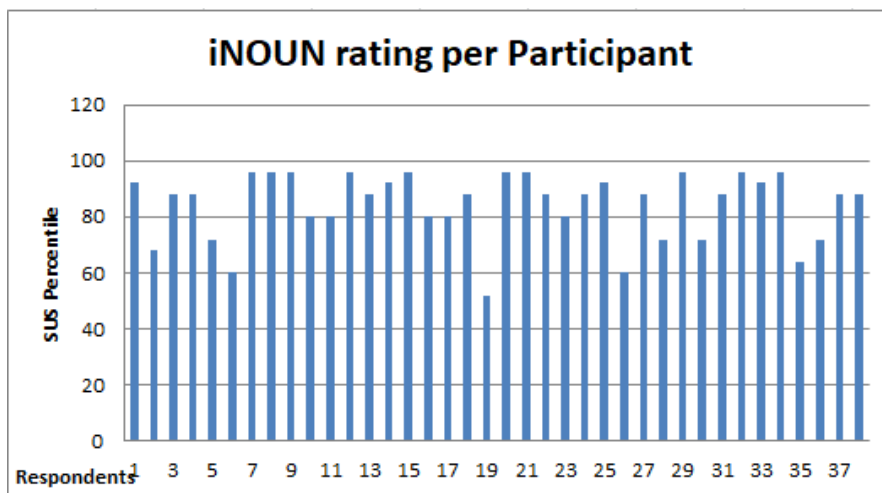


Figure 3. Ratings by participants

Only a marginal 4 Respondents on overall has an index below the average. On collation of the entire survey response and feedback, the iNOUN Chatbot rate based on the standard of System Usability Scale is evaluated as 84.2% percentile, which is a level high above the average 67 percentile.

Based on the survey, 69% of the respondents reviewed the system to be beyond average rating and considers the system Usability index high enough to represent a Human responder. The iNOUN Chatbot is regarded as both usable, and learnability factor is seen high as fewer respondents require additional learning in order to be able to interact and respond to the iNOUN.

Only a marginal 4 Respondent on overall has an index below the average with a total rating of 52, 64, 60 and 60 percentile from the 1<sup>st</sup>, 3<sup>rd</sup>, 6<sup>th</sup>, 8<sup>th</sup> and 9<sup>th</sup> Respondent. On collation of the entire survey response and feedback, the iNOUN Chatbot rates based on the standard of System Usability Scale is evaluated as 77% percentile which is a level high above the average 67% percentile.

The survey gave the respondent an opportunity to state questions asked during the interaction with iNOUN that the Chatbot was unable to provide concise or suitable answers adequately. These responses were collected following the adoption of the incremental developmental approach in the design phase, which involves a continual increment of the knowledge base to support newer knowledge to be able to provide better answers.

Conclusively, the iNOUN Chatbot received high usability rating and perception of user based on experience and testing of the iNOUN which is considered good enough for adoption to help represent the human agent in responding and holding a conversation on general or straightforward enquiries regarding the National Open University of Nigeria

The iNOUN chatbot is able to provide several benefits.

1. It provides students with powerful and personalized conversational experiences irrespective of day or time.
2. It is not prone to fatigue or boredom and is less likely to make errors.
3. It is able to free up for human resources so they can devote attention to more complex and critical tasks
4. It has the potential of being cost-effective and time-efficient compared to manual methods

## Conclusion

Live Assistants or Chat Bots are proving to be the next technological advancement in providing a better and unprecedented digital experience and strong student support. This paper has briefly reviewed past literature and present work that are related to the usage of Artificial Intelligence in form of a conversation Chatbot which helps tends to complement the human support staff and teachers. It describe the iNOUN chatbot which is capable of answering frequently asked questions. The bot was found to be usable and provided good user experience.

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