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# Impact of Integrating Chatbots into Digital Universities Platforms on the Interactions between the Learner and the Educational Content

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A B S T R A C T

*The rapid expansion of digital universities across Africa addresses the need for scalable higher education solutions, but challenges such as limited physical infrastructure and high dropout rates persist. In digital learning environments, effective interaction with educational content is crucial for student success. This article explores the transformative role of chatbots integrated into digital university platforms, with a specific focus on their impact on learner-content interactions. Leveraging the frequent use of messaging applications and advances in Artificial Intelligence (AI), we examine how chatbot integration enhances student engagement, facilitates personalized access to core educational modules, and supports formative assessments to reinforce learning outcomes. Using the Rasa open-source framework and the Moodle Learning Management System (LMS), we present a model that not only delivers content efficiently but also provides an interactive learning experience through AI-driven dialogue systems. Furthermore, a comparison of the different AI tools used for educational chatbots will be presented, to determine the most suitable solutions for digital teaching. This analysis will consider various aspects such as efficiency, customization, flexibility and ease of integration of the tools into educational environments. This study highlights how chatbots can foster a more dynamic and responsive learning ecosystem, ultimately improving student retention and mastery of key concepts in digital universities. In this article, we explore the broader impact of chatbots on learner interaction with educational content, not just their integration. It also emphasizes student engagement and retention.*

## 1. Introduction

In recent years, digital universities have emerged across several African countries as a response to the growing demand for higher education. To address the challenges of massification and limited physical infrastructure, various digital universities [1], [2], [3] have introduced innovative pedagogical models, often relying on open digital spaces (ODS) to complement virtual environments. These ODS provide students with collaborative spaces to address pedagogical, technical, administrative, and social issues [4].

Students in digital universities primarily rely on distance learning platforms to access their educational materials. However, challenges related to the user experience and accessibility of certain Learning Management Systems (LMS) have contributed to increased dropout rates. To address these issues and improve access to educational content, universities have implemented various solutions, such as integrating social media and providing pedagogical support through tutors.

To further enhance the interaction between students and educational content, this paper proposes the integration of a chatbot into digital university platforms. By offering an intuitive and responsive interface, the chatbot aims to streamline content access and improve the overall learning experience. A chatbot is an advanced tool for automated, context-aware communication

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between users and systems, utilizing natural language processing for a conversational approach [5].

The remainder of this article is structured as follows: first, we will examine the related work in this area, followed by an overview of fundamental chatbot concepts. Next, we will discuss the design and implementation of our proposed solution, concluding with insights for future development.

## 2. The State of the Art

Artificial intelligence has left no stone unturned. Several researchers specializing in the field have carried out studies on the impact of AI in the education sector, and in digital universities.

Such is the case of authors of [5] who, in their article, propose the integration of conversational chatbots for educational remediation within the framework of covid-19. Among other things, the chatbot enables learners to self-train on parts of the course they haven't quite mastered.

It is connected to a Moodle platform, enabling learners to continue their learning at a distance. The chatbot is integrated as a Moodle plugin and can be used on other LMSs.

Researchers in [6], who propose and describe a new recommendation approach based primarily on the use of a chatbot linked to the Moodle platform.

The authors in [7], have proposed an intelligent agent in the form of a chatbot on the IBM Bluemix platform. This agent automates interaction between users and the Moodle training platform. This is a very interesting proposal, but it is specific to a technology belonging to IBM.

In [8], the authors set up a chatbot for a mobile application enabling interaction between users and a Moodle LMS platform. This tool is used on a specific LINE Chat application and meets a need of the Japanese community.

In [9], the authors have proposed a methodology to improve the quality of e-learning, chatbot architectural design, to help learners self-regulate their learning by accompanying them via a chatbot within the Moodle platform, which constitutes a metacognitive virtual assistant.

In [10], the authors with their chatbot in place, have enabled their institution's administration to reduce the amount of work they have to do to provide the required information to students, thus reducing their workload by continuing to answer all student questions. They also confirm that chatbot systems can be used in a wide range of sectors, including education, healthcare and marketing.

In [11] the authors conducted a comprehensive survey of recent deep learning techniques for chatbots, enhancing developers' understanding of effective chatbot design. In [12], the authors illustrates the design and development of illustrate at bot software, which integrates with a user website to manage student queries through defined intents. The article discusses the chatbot system utilizing a Recurrent Neural Network (RNN) for language processing, a Convolutional Neural Network (CNN) for image handling, and Dialogflow for intention and entity representation, along with keyword matching techniques. In [13], the authors have created three chatbots to support teaching in their university's Department of Electronics and Multimedia Telecommunications. The first, KEMTbot, is available on the department's website, providing information from the web and about the staff. The second chatbot assists students during exercises in the "Databases" course, while the third is an Amazon Alexa skill that responds to questions regarding the department on Amazon Echo devices.

## 3. Presentation of Artificial Intelligence (AI) tools used for educational chatbots

Natural language understanding (NLU) platforms are at the core of all chatbots. Conducting a comparative analysis of tools like Rasa, IBM Watson, Dialogflow, and TensorFlow is crucial to assess their strengths, weaknesses, and suitability for educational platforms such as Moodle.

### *3.1. Rasa*

Rasa [14] is an open-source software that includes two main modules: Rasa NLU and Rasa Core. Rasa NLU focuses on natural language understanding, while Rasa Core handles dialogue management. The goal, according to its creators, is to bridge the gap between research and real-world applications, bringing recent advancements in machine learning to a wider audience, including those with limited experience who want to develop conversational agents.

### *3.2. Dialogflow*

Dialogflow [15] is a natural language processing (NLP) platform developed by Google that enables the creation of chatbots and virtual assistants capable of understanding and responding to user interactions in natural language.

### *3.3. TensorFlow*

TensorFlow is an open-source platform developed by Google, designed for machine learning and artificial intelligence applications. It provides a comprehensive library and flexible ecosystem of tools that allow developers to build and deploy machine learning models efficiently. TensorFlow is widely used for tasks such as natural language processing, image recognition, and deep learning, making it an essential tool for developing sophisticated AI applications, including chatbots [16].

Its scalability makes it a popular choice for integrating intelligent capabilities into digital learning platforms.

### *3.4. IBM Watson*

IBM Watson [17] is notable for its robustness and capacity to handle vast amounts of data. It offers predefined templates tailored to various sectors, such as banking, and includes a visual dialog editor, making it accessible for non-programmers to create conversation flows easily. In [18], the authors analyze this platform alongside others in terms of functionality and usability.

To summarize, this description of AI tools used in educational chatbots will offer a technical reference guide to help select the most suitable solutions for the needs of digital universities, while also delving into the technical aspects of integrating chatbots into learning systems like Moodle.

## 4. Basic Concepts and Tools Used

To provide a foundation for understanding the integration of chatbots in digital learning environments, this section will cover the fundamental concepts and tools essential for developing and deploying chatbot solutions in educational contexts.

### *4.1. Chatbots*

The first Chatbot, ELIZA, was developed by Joseph Weizenbaum at the Massachusetts Institute of Technology (MIT) in 1966. Researchers define chatbots in various ways, including terms such as conversational AI entities, virtual assistants, chatterbots, digital assistants, and chatbots. Regardless of terminology, the primary goal of a chatbot remains to simulate human conversation. [19], [20], [21].

Advancements in Artificial Intelligence (AI) and Machine Learning (ML) have positioned conversational agents as essential tools across various industries. Many organizations adopt these solutions to both reduce physical staffing needs and enable rapid, automated responses based on predefined implementation criteria [22].

A conversational agent, also known as a chatbot or dialogue system, interacts with users in natural language, enabling it to understand and respond in a way that resembles human conversation. These systems can operate through text or voice-based interactions [23].

Conversational agents are widely applied in fields such as human resources, healthcare, and education, showcasing their versatility and impact across diverse sectors [24], [25].

### *4.2. Moodle*

Moodle (Modular Object-Oriented Dynamic Learning Environment) is a free Learning Management System distributed under the GNU General Public License. It is developed in PHP. In addition to the possibility of creating courses with integrated tools and categorizing content by course, cohort level, sub-category, etc., the platform offers the possibility of being interconnected with external tools via secure APIs.

### *4.3. Interoperability between the chatbot and the Moodle platform using API*

An API (Application Programming Interface) is a tool enabling different systems to communicate with each other. It defines the methods by which the two systems can communicate.

Moodle offers several APIs for interaction between the chatbot and its system. To retrieve data from the Moodle platform, authentication is required via a time-limited Token. To enable the chatbot to access the APIs, an authentication function must be implemented [26].

### *4.4. Natural Language Processing (NLP)*

NLP (Natural Language Processing) is a branch of computer science focused on developing systems that enable computers to communicate with people using everyday language [27].

The intelligent conversation system is the foundation on which all Chatbots are built. It enables us to understand user requests and respond in a relevant way. This type of system is often built on top of an understanding and categorization algorithm. Let's now focus on the different elements of language processing: NLG (Natural Language Generation) and NLU (Natural Language Understanding).

Most chatbots operate on a basic model of these three properties, namely: Entities, Intentions, Response.

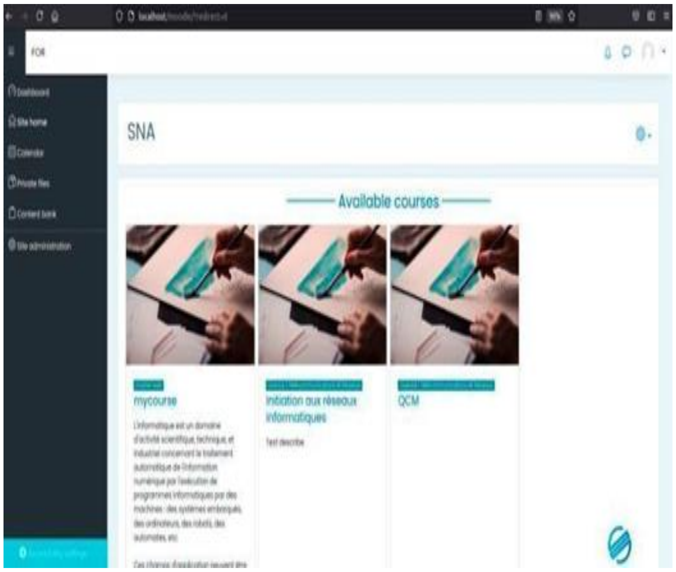


Figure 1: Moodle Platform Homepage

### *4.5. Key stages in the learning process*

The first part consists of creating the NLU and discussion models, commonly known as the training phase. As Rasa is based on Machine Learning, it requires training data.

- For the NLU part (Rasa-NLU), the training data are sample sentences that the user might utter, in which intent and entities are specified. A configuration file is also required to set the algorithm parameters.
- For the discussion part (Rasa-CORE), a set of stories must be defined so that the agent learns to choose its next action. The configuration file accompanying the stories contains lists of intentions, entities, slots and actions.

### *4.6. Advantages of integrating chatbot into the learning system*

An API (Application Programming Interface) is a tool enabling different systems to communicate with each other. It defines the methods by which the two systems can communicate.

Moodle offers several APIs for interaction between the chatbot and its system. To retrieve data from the Moodle platform, authentication is required via a time-limited Token. To enable the chatbot to access the APIs, an authentication function must be implemented.

## 5. Solution Implementation and Results

The implementation of a conversational agent involves several stages, including preparation and selection of the solution, development, and finally management and continuous improvement.

### *5.1. Chatbots*

The first Chatbot, ELIZA, was developed by Joseph Weizenbaum at the Massachusetts Institute of Technology (MIT) in 1966. Researchers define chatbots in various ways, including terms such as conversational AI entities, virtual assistants, chatterbots, digital assistants, and chatbots. Regardless of terminology, the primary goal of a chatbot remains to simulate human conversation.

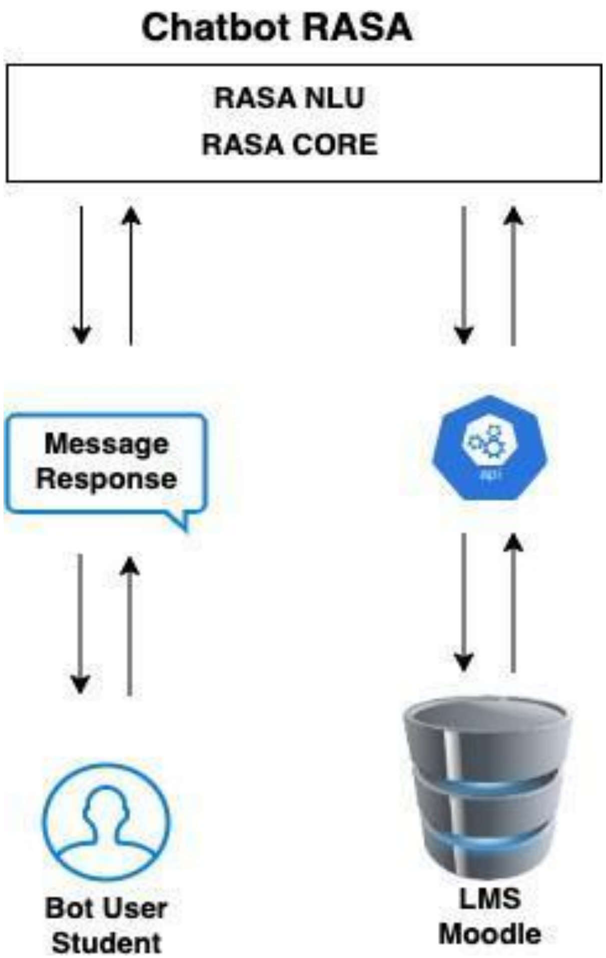


Figure 3: System architecture

### *5.2. Solution Development*

There are several stages in the development of the solution:

- Step 1: Installing Rasa
- Step 2: Project creation
- Step 3: Defining intentions and examples
- Step 4: Defining responses
- Step 5: Creation of dialogue stories
- Step 6: Model training and testing
- Step 7: Creating the graphical interface

Once the prerequisites have been set up, the next step is to train the model and test it in console mode.

Below are additional features that we have implemented to predict the learning outcome and to personalize the learning path.


Figure 2: Moodle authentication and token recovery function

- **Learning Outcomes Prediction**

The objective is to leverage predictive analytics to forecast student performance based on their interactions with the chatbot. The predictive analytics model will use below data sets:

***Data Collection**:*

- Interaction Logs: Collect detailed logs of student interactions with the chatbot, including questions asked, resources accessed, and response times.
- Performance Metrics: Gather data on student performance in assignments, quizzes, and exams.
- Behavioral Data: Track engagement metrics such as login frequency, time spent on different types of content, and participation in discussions.

***Predictive models:***

We use regression models to predict grades or performance scores based on interaction data. The grades and performance will then be used by a neural networks model to categorize students into different performance levels (e.g., at risk, average, high performer). Finally, we applied time series analysis to monitor and predict changes in student performance over time.

***Model Evaluation:***

Cross-validation techniques are used to assess the accuracy and robustness of the predictive models. Precision and F1-Score are used to evaluate the models.

- **Personalized Learning Paths**

The objective of this feature is to create algorithms that adapt educational content and recommendations based on the student's progress and learning style.

**Presentation of the algorithms:**

- **Content Recommendation:** Develop recommendation algorithms that suggest tailored content based on the student's learning style and knowledge level.
- **Progress Tracking:** Implement systems to continuously monitor student progress and adjust learning paths dynamically.
- **User Feedback:** Collect feedback from students on the

usefulness and relevance of recommended content to refine the algorithms.

After configuration and testing, it's important to set up a graphical interface enabling users to interact with the system. This interface defines the access parameters for the Rasa chatbot.

After finalizing the creation of the chatbot in console mode, we created the graphical interface enabling us to interact more easily with the chatbot.

```
<body onload="checkCookie()">

  <div class="chat-container"></div>
  <div class="profile_div" id="profile_div">
    <img class="imgProfile" src="static/img/botAvatar.png">
 </div>
  <script src="Chatroome.js"/></script>
  <script type="text/javascript">
    botimg = document.querySelector(".profile_div");
    var show = true;
  botimg.addEventListener("click", function(){

    var chatroom = new window.Chatroom({
      host: "http://localhost:5005",
      title: "SNA ChatBot ",
      container: document.querySelector(".chat-container"),
      welcomeMessage: "Bienvenue sur le chatbot de SNA",
      speechRecognition: "en-FR",
      voiceLang: "en-FR"
    });
    chatroom.openChat();
    botimg.style.display = "none";

   if(show){
    divchat = document.querySelector(".chats");
    var node = document.createElement("img");
    node.src="https://i.postimg.cc/7hFwJtZZ/Logo-en-bleu.png";
    node.style.textAlign = "center";
    node.style.display="block";
    node.style.marginLeft="auto";
    node.style.marginRight="auto";
    node.style.width="80%";
    divchat.insertBefore(node, divchat.firstChild);
    show = false;
   }
```

Figure 4: Code of Chatbot graphical interface

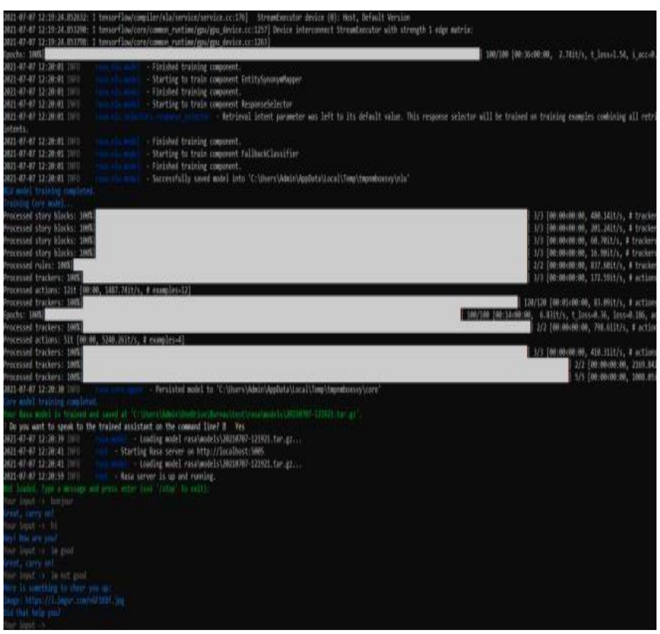

Figure 5: Model training

### 5.3. Steering and Continuous Improvement

Depending on the indicators set to measure the system's performance, it is important to measure the rate of understanding of the entities' performance, and to make continuous improvements by adding responses as the system is used.

### 5.4. Results of our studies

In this paper we have studied the impact of integrating chatbots on digital university platforms. The objective of our work was to demonstrate that the integration of chatbots into digital university platforms aims to improve the interaction between learners and educational content, while considering the specificities of distance learning. We designed and implemented a solution that allows us to validate our study.

The results of our studies show the following benefits:

First, the interactions between learners and educational content have increased significantly. This improvement is especially notable in areas such as forums activities and the facilitation of virtual classes, where the chatbot helps create a more engaging and supportive learning environment. Indeed, by providing real-time support and allowing automated responses to common questions, chatbots promote active discussions and encourages collaboration in the forums activities. The consequence of this is a reduction in dropout rates.

The other results were that we noticed the enhancement and diversification of digital content. By offering personalized content recommendations, providing interactive resources, chatbot adapts the learning experience to individual needs. This dynamic content support enhances the learning journey, making it more accessible for students.

Furthermore, the integration of the chatbot improves the assessment framework within the digital platform. By automating the formative quizzes and providing feedback, chatbots support learners in understanding and mastering core concepts, making assessments a more continuous and interactive part of the learning process.

## 6. Conclusion and Perspectives

To provide a foundation for understanding the integration of chatbots in digital learning environments, this section will cover the fundamental concepts and tools essential for developing and deploying chatbot solutions in educational contexts.

In this paper, we explored the integration of a chatbot into digital university platforms to enhance the interaction between learners and educational content. The chatbot, powered by Artificial Intelligence (AI), Machine Learning (ML), and built using the Rasa framework, was connected to the Moodle Learning Management System (LMS) to enable learners to self-train effectively, particularly in core IT modules. By leveraging natural language processing, this chatbot provides a seamless and intuitive way for students to access educational resources and engage with learning materials in a more dynamic and responsive manner.

As AI technology continues to evolve, our next step will be to extend the capabilities of this chatbot by integrating it with systems like ChatGPT. This will enable learners, including those outside of the Moodle platform, to ask questions and receive personalized support across various fields of study. By doing so, we aim to create a more comprehensive and accessible tool that can serve a broader range of students, making the chatbot an invaluable resource for learners across different academic disciplines.

This work allowed us to explore how the integration of chatbots into digital university platforms can help reduce dropout rates, particularly in the most demanding courses or those where the failure rate is historically high. Indeed, considering the statistics of previous studies, the use of chatbots could impact student retention in programs, by comparing the rates before and after the integration of the chatbot.

In order to strengthen the results obtained, several avenues for improvement are planned:

Integration with advanced AI systems, such as ChatGPT, to allow an even more contextualized response to student questions on various subjects.

Improvement of the user interface to further facilitate access to educational content and modules.

Development of additional features for the continuous assessment of student performance via more sophisticated predictive models.

The integration of chatbots into digital universities transforms access to educational content and improves learner engagement. Through AI and adaptive systems, students benefit from a personalized, dynamic and enriching experience, which helps improve their academic success in digital environments.

### Conflict of Interest

The authors declare no conflict of interest.

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