IBM Watson Application as FAQ Assistant about Moodle

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***Abstract*—This complete research work presents the use of chatbot in the educational context for automation of care to the student of higher education. Due to the evolution of technologies in educational and professional contexts, new teaching/learning methods have been an emerging demand for today's society. The expansion of learning modalities such as face-to-face, combined and distance learning as well as demand anywhere, at any time, has been a premise in these education systems. With the advancement of virtual learning environments (VLEs), successful interaction depends on solutions that enable efficient communication between the student and the educational context. One way to achieve this goal has been to use chatbots to respond to students' questions in the educational field. This has become possible through artificial intelligence and natural language processing embodied in simple service platforms. The purpose of this article is to develop a chatbot that interacts with students through text messages, on subjects in a closed context, to students' doubts about the Higher Education Institution Course. To validate chatbot performance, it will be submitted to a set of questions of the same context that were not correctly answered in the previous interactions. The results of these interactions will be analyzed in order to verify the efficiency and contribution of a chatbot as a support tool for the student. It is hoped that this study contributes to solutions for assistance automation in the learning context.**

***Index Terms*—Chatbot, AVA, IBM Watson**

I. Introduction

With advances in Artificial Intelligence (AI) research to understand human thinking and behavior, new findings contribute to improved communication. Often technologies are being incorporated into devices and revolutionizing Human-Computer Interaction in Virtual Learning Environments (Moodle). In this scenario are present the virtual assistants or robots of conversation, denominated Chatterbots. A Chatbot (bot) is a virtual assistant designed to simulate a conversation by means of text messaging, similar to Short Message System (SMS) [1].

The chatbots to simulate human activities by interacting and working with students in virtual environments [2]. According to [3], usually the interaction with a chatbot starts from the introduction of a question or sentence, by the student, then the software embarked on the chatbot answers the question, makes a comment or starts a new topic.

According to [4], a bot can be defined by two types: (i) rule-based, where its responses are defined by previously created principles, and the bot can not process information or commands outside of existing specifications. For this type of bot, intelligence is limited by the set of rules; and (ii) based on Artificial Intelligence techniques, which learn from interactions with students. These bots use Natural Processing Processing (NLP) to provide accurate and dynamic responses.

Several companies have been investing in AI, among them, IBM in recent years has been upgrading its Artificial Intelligence Web platform called Watson, which enables applications to be developed for different business models, including chat robots [5] that use NLP for human students may have natural interactions that flow freely with virtual robots [6]. In this way, the use of bot has been used as a virtual assistant to attend to students autonomously.

In recent years there has been a significant growth in the popularity of chatbots. The search for the term "Chatbot" performed on web search engines confirms this growth, through Google Trends it was possible to query the term and obtain the history from a given period, as shown in Fig. 1.

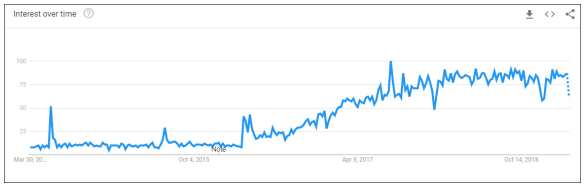

Fig. 1. Search frequency of the term Chatbot with filters: past 5 years and worldwide. (Google Trends, 2019).

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From the question that forwards this work is; What is Watson? From the reading of published articles, we present some of the possible answers:

a) It is a system of cognitive computing: inserted in the universe of Artificial Intelligence [7]. The term cognition is related to the acquisition of knowledge through some processes such as; observation, precept, association, relationship, reasoning, and memory [8].
b) It is used to improve human performance [9] in a wide range of market segments.

In 2011 Watson gained visibility by beating two of the best human players on the Jeopardy program! an American television gameshow. According to IBM, it is capable of analyzing 200 million pages of data and answering any question accurately in less than three seconds, you can think, just teach it about your business model and then have a powerful ally capable of take decisions based on a knowledge difficult to be reached by humans.

Among the main features of Watson are:

i. **Discovery:** market analysis, understanding its variations and based on objective data, enhance business competitiveness. Interpreting social networks and analyzing people's feelings about their company allows a clear view of Marketing Share. Analysis of objective and restricted data to your business and generating information through the correlation of documents that are often unstructured and impossible to analyze by the human being.

ii. **Conversation:** construction of virtual assistants or bots to be used in various communication channels.

iii. **Language:** Translation, interpretation and classification of language and to infer the most relevant information of documents.

iv. **Vision:** Recognizing images, analyzing them, classifying using machine learning, and returning useful business information.

v. **Empathy:** Understanding of emotions, personality analysis, values from the written text.

This work aims to develop a bot for text interaction to assist students of the distance learning mode in the use of the virtual learning environment (AVA) Moodle. To achieve this, the following speci fi c objectives were established: Analyze pre-existing academic bot models;

A. Identify the main chatbot development platform and their characteristics, concordances and disagreements;

B. Monitor the interactions that produce failures and apply Machine learning to the bot in order to refine it to reduce these failures;

C. Implement and integrate the bot to AVA Moodle;

D. Evaluate the results of interactions after chatbot training.

The paper is organized as follows: Chapter II presents Chatbots in the context of teaching. The following chapter presents the methods used to create the bot, the case study for Chabot deployment, observing three axes: domain, model and knowledge base. Chapter IV presents the results and discusscions. Chapter V presents the conclusion and future work.

II. CHATBOT IN LEARNING CONTEXTS

The use of bots capable of performing automatic attendance to students is nothing new. Its ef fi ciency in simulating conversations on speci fi c topics from a set of pre-established questions and answers allows automating routine and repetitive tasks. In this perspective, [11] suggests a bot for library attendance with the premise that the virtual assistant offers a more interactive student experience. In order to diversify learning, [12] presents a teaching methodology based on virtual 3D worlds where a bot is used to interact with students about basic concepts in the area of software testing.

For [12], the results showed that a construction of knowledge and interaction between people in the virtual world contributes to the decrease of the isolation and the solitude of the individual. Another important work is the National Program for Rationalization of the Use of Petroleum and Natural Gas Derivatives (CONPET), which uses bots to raise awareness of the rational use of energy, [13]. CONPET developed the ED Robot, which is equipped with Artificial Intelligence, capable of interacting with thousands of students simultaneously imitating a real attendant.

The robot explains about issues related to the rational use of energy, petroleum products, the environment, natural gas and also gives tips on economy, air quality, biofuels, educational programs, alternative energy sources and other topics. To support teaching in a higher-level course, [13] implement the prototyping of a bot as a teaching method, in the classroom, for students of the Information Systems course.

The results showed gains in learning and a greater engagement of the students who participated actively in the construction of the bot. In many works, bots enable the collection and storage of information exchanged with students for potential queries in the form of reports or for analysis in decision-making [15].

The distance courses, or EAD, of Public Higher Education Institutions (IPES) in Brazil, play an important role in the training process of their students. In the Higher Education Census of 2017, carried out by INEP, the number of enrollments in undergraduate courses decreased by 0.4% between 2016 and 2017. In the distance modality, the increase is 17.6% (Fig. 2 the highest percentage recorded since 2008. Between 2007 and 2017, distance undergraduate enrollment increased by 375.2%, while in the face-to-face modality, growth was only 33.8% in the same period.

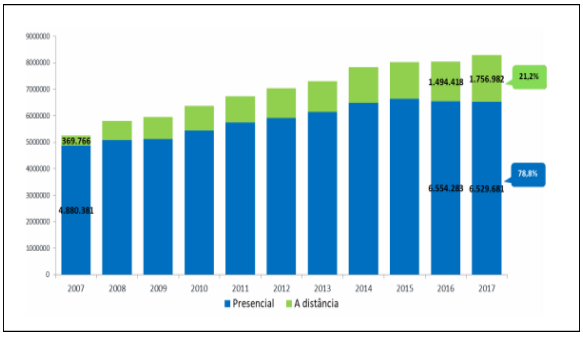

Fig. 2. Number of enrollments in Undergraduate Courses by Mode of Education 2007-2017 (INEP, 2019).

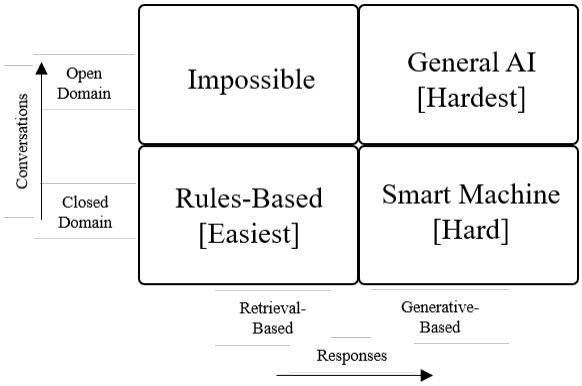

Fig. 3. Kojouharovss Chatbot Conversation Framework - adapted.

Among the actions of these courses in relation to student attendance are: clarification of doubts of academic, administrative, orientation about the courses and their pedagogical tools. In view of the constant emergence of demands for student attendance in teaching platforms, it is necessary to rethink processes for the improvement in the interaction with the student in these environments [6].

In a survey carried out at a Higher Education Institution of Southern Brazil (IES), information was obtained on the most frequent questions asked by the students in the 22 courses in the EAD mode that IES offers. The information was obtained through the information technology sector of the IES, responsible for answering the student's questions about Moodle. The main questions and questions about Moodle were used as a knowledge base for the development of an automated solution for student assistance.

In this sense, the use of bots in a first moment will help the IES in reducing the number of queries regarding doubts about Moodle. Among the technologies to develop bots are the cloud-based platforms for developing and deploying attendant bots, such as Microsoft bot Heroku among others.

According to [1] after conducting a comparative study between different web platforms for bot development, it is concluded that cloud-based platforms have a distributed synchronicity of intelligence.

According to [17], the only way to build a smart bot is to develop a response-generating model in an open conversation domain, as can be seen in Fg. 3 next: the conversation domains of the bot as open or closed. A bot in a closed conversation domain comprises a limited number of questions about a given domain, whilea bot in an open conversation domain should be able to understand any question or input given by the student.

The domain understood by the bot in the context of learning consists of the set of frequently asked questions regarding the use of Moodle. In the response generation domain, a bot can have two approaches: (i) recovery-based: the bot will use a repository of pre-defined data, responses, and some kind of parameter to choose the most appropriate response based on input and context.

The parameter can be simple, as in a rule-based or complex expression, as in a set of machine learning classificers. Anyway, these bots do not generate a new string, they just select a response in a fixed set. Generator bots are the most complex to be developed because they do not use predefined responses, they generate new responses from models. Generator models are typically based on Machine Translation, but instead of translating from one language to another, the translation is done from an input to an output or response. In this case, the student-robot interaction process starts from the question posed by the student. With the use of natural language processing (NLP) and AI, the interaction resembles human-to-human conversation, in which case the bot processes responses to student care.

A. Plataforms for chatbot development

Based on the need to choose a platform for the development of chatbot, a survey was carried out to identify the main available, analyze and choose the one that best meets the proposed criteria; (i). text messaging support; (ii). multiplataform; (iii). free. The Fig. 4 shows the main platforms for the development of chatbots and their characteristics.

Features/Plataform	Botpress	Botkit	MSBF/LUIS	Diagflow	Wit.ai	Lex	Chatfuel	IBM Watson
Open-source	x	x						
No coding/ customization required				x	x	x	x	x
Integrated with natural language processing	x		x	x	x	x		x
Content Management	x			x			x	x
Native natural language processing	-			x	x	x		x
Integrate bot analytics	x			x			x	x
Custom analytics	x					x		x
Modular architecture	x					x		x
Extensible	x	x				x		x
Free of nip provider lock-in	x	x	x					x
Avaliable on-premisses	x	x						x
Avaliable on the cloud	x	x	x	x	x	x	x	x
GUI fo non-technicals	x			x	x	x	x	x
Extensible dialog Management (DM)	x							x
SLA avaliable	x							x
Voice-enable	soon		x	x				x
Support avaliable	x							x
Connect to internal and external services	x	x	x					x
Mult-lingual	x			x			x	x
Role-based user acess control (ACL)	x			x		x	x	x
Built-in Human-inthe-Loop (HITL)	x							x
All messages channels (event custom)	x	x						x

Fig. 4. MAIN PLATAFORMS FOR CRIATING BOTS.

Looking at the proposed criteria and the individual characteristics of each platform, Watson has proven to be robust, offers a free plan, is free of coding and combines NLP intent classification, conversation management.

In order to deploy bots it is necessary an architecture formed by: (i) technologies that offer simultaneous access, distance and high availability to bot, that is, that allow full- time access to students; (ii) an application responsible for the analysis and processing of the natural language of the messages sent and received; (iii) an accumulated knowledge base in charge of storing all information inherent to the bot's knowledge domain.

Students interact with the bot through an interface that can be developed, or use ready-made interfaces such as social media messaging services. The bot receives the input and forwards it to the Application module that connects to the Conversation service module, a container for the dialog flow and training data. This interprets the text, directs the flow of interaction, and gathers all the information necessary to respond to or execute a student transaction.

The Application module has the function of making the connection between the messaging services and Watson. Finally, the Analytics module is responsible for monitoring and recording and storing interactions made with students, allowing you to identify the unanswered questions successfully and thus, train the bot to answer such questions. The architecture is demonstrated in Fig. 5 below.

The Watson platform is free for up to 10,000 messages per month [18], has broad compatibility with today's leading messaging platforms and is user friendly. Some of its main highlights are:

- *Intention based on Artificial Intelligence and Entity recognition*;
- *Entity Synonym Recommendations*;

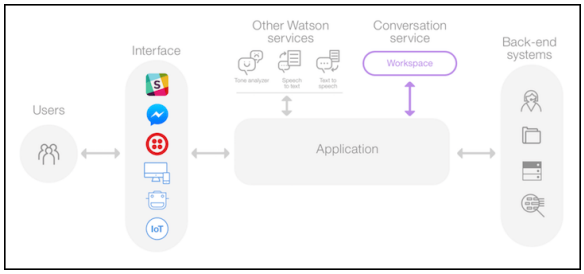

Fig. 5. Watson Assistant architecture overview (IBM, 2019).

- *Visual Editing of Dialogues, with simple response types (text, options, images, etc ...);*
- Pre-built content available;
- *Google Analytics dashboard with seven days of storage*;
- *5 dialogue skills, each with 100 nodes of dialogue; Shared public cloud.*

Watson has has a knowledge base, runs Natural Language Processing, hosts the application and its interface of communication and interaction in Facebook Messenger. Several successful bots operating in various industries, such as Harman Connected Services (which is part of Samsung) was featured in a prototype of the Watson embarked on a Maserati supercar. Munich Airport in Germany is also using the Watson Assistant within its Pepper robot to give visitors guidance, and Autodesk is using it to power the Autodesk Virtual Agent to respond quickly to the most common queries of customers. The Royal Bank of Scotland was one of the first to use Watson.

The bot's knowledge base is the set of rules pertaining to the topic domain, the questions and their answers to the most common questions asked by the students. The I.A. allows you to recognize words or phrases in your caller's message to process the best response based on the set of rules and responses.

For example, from the "File upload" sentence, the bot perceives and identifies the student's intention: send a file to Moodle, then it responds to the most appropriate request with the student's intention. At the end of the service, the flush for the restart of the service is triggered and the bot offers to help in any further questions with the following question "Can I help you with anything else?" And the student answers "no". The conversation closing flush is activated and the bot sends the message "At any time, you can call me" which makes it possible to restart a new service.

III. METHODOLOGY FOR BOT DEVELPOMENT

A. Bot Integration

The following steps were necessary to perform the integration of the bot via Facebook Messenger interface to AVA Moodle:

Step 1: Create the API for the bot on Facebook, to get the application access Token, it is responsible for providing

permission for the Watson API to read, write or modify the bot page data.

Step 2: Connect the Bot to Facebook Messenger via the Page Access Token, generated in the creation of the API described in step 1. The page access token is required to modify and read the application settings. It is generated using a credential previously agreed between the bot and Facebook, and is then used during calls that change the settings of the entire application. It is actuated through a server-to-server call.

Generated callback URL-Webhook: This is the return address that allows the bot to receive HTTP notifications in time, from changes to objects. The Messenger Platform sends events to the bot's webhook to notify you when interactions occur. Webhook events are sent as POST requests.

Step 3: Insert the bot into the AVA Moodle: The interaction interface of the bot with AVA Moodle students was made available using the script generated by the bot's API and was added to the HTML code of the AVA page to promote interaction with the students from various distance education courses.

The preliminary tests were carried out with a set of basic doubts about AVA Moodle.

B. Data Colletion and Analysis

Bot interactions with students occurred for an established period of four weeks. At the end, the interactions were collected and analyzed and classified according to the criteria investigated. For analysis, we chose to identify and classify the interactions in three groups: 1 correct answers; 2- out-of-context questions; 3 - wrong answers.

In total, 14 interactions were performed: six correct answers, six out of context questions and two unanswered questions. Considering only the number of right answers and wrong answers, we have a percentage of 75% for the correct answers and 25% for the wrong answers, for a total of eight responses counted. Fig. 6 shows the classification of interactions.

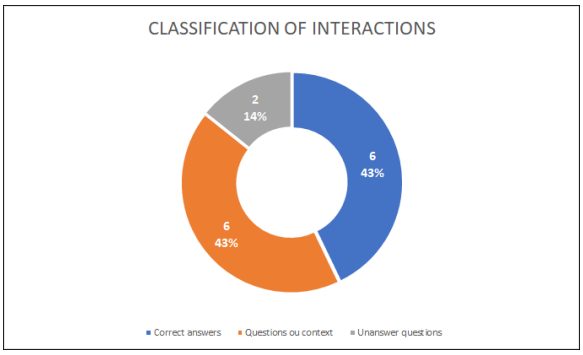

Fig. 6. Classification of interactions.

Table I shows the separate answers and classified according to the categories that were analyzed: correct answers, incorrect answers and questions out of context.

The Fig. 7 below shows the number of users who interacted with the bot within 4 weeks of use.

TABLE I
CATEGORIZATION OF INTERACTIONS

Correct Answers	Questions out of context	Unanswed Questions
Redefinir-senha	Saia da minha tela, por favor	como me inscrever num curso pela primeira vez
Tutoriais-moodle	Quero fazer um curso de formação em tutoria	não alterei minha senha e nem usuario, não consigo acessar
Logar-se-no-moodle	Boa tarde, esse curso e para já formado?	
Como enviar mensagem	Quando voltam às aulas da minha pós?	
Matricular na disciplina	Gostaria de saber o meu número	
Enviar tarefa	Como fao para conseguir uma carteirinha de estudante?	

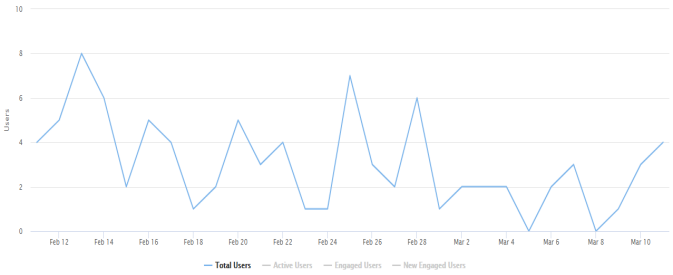

Fig. 7. Number of students interacting with the bot in the 4 week period.

C. IBM WATSON aplication

In order to automate student service, it was proposed the application of a bot, equipped with Artificial Intelligence, from IBM's cognitive services platform to improve the students' use experience, offering them fast and assertive answers in the context of established issues.

Watson allows the construction of integrated AI conversational interfaces bots that employ on any channel,including mobile applications, customer care tools, websites and smartphones [6]. Supported by more than thirteen languages, Watson students can communicate more effectively and reach a broader global audience. Watson can also store conversations and learn how to further customize the virtual assistant interaction experience. Over time, conversations stored by Watson can become a repository of data related to student preferences engagement.

Fig. 8 below illustrates the proposed architecture for bot development.

In the proposed architecture, the student has access to the AVA Moodle web interface, through a computer or mobile devices, and AVA adds the use of technologies such as HTML, CSS, JavaScript and PHP. The application is hosted on the IBM Cloud, making it a fully web service. a knowledge base is generated "Knowledge Data-Watson". To answer the questions asked by the students the bot uses the "Watson API" to integrate with the chosen channel, in this case Facebook Messenger.

The first step in building the bot was to train you to

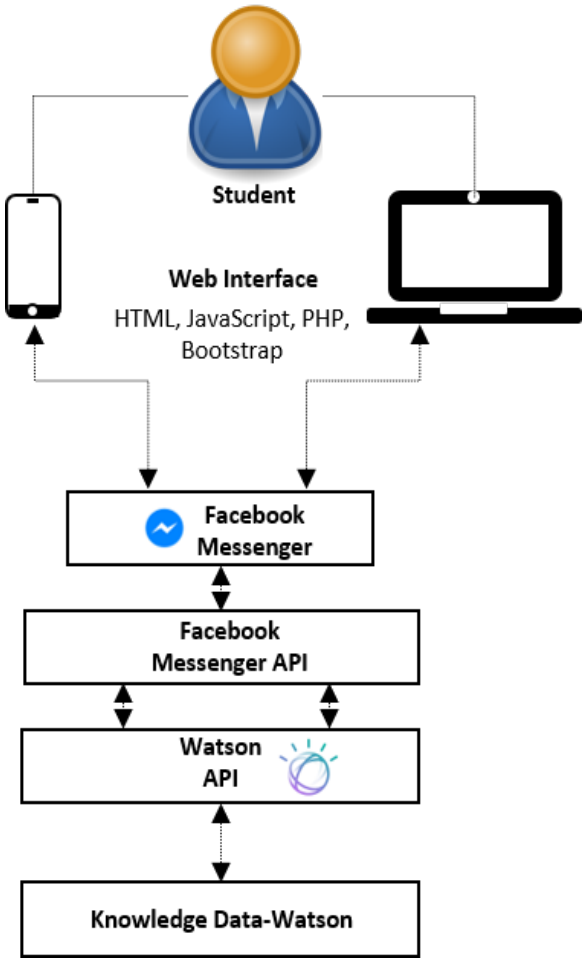

Fig. 8. Bot Watson Architecture: conversations flow.

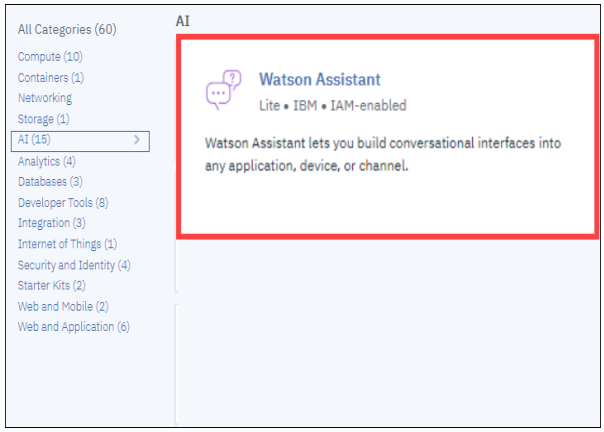

Fig. 9. Bot creation panel.

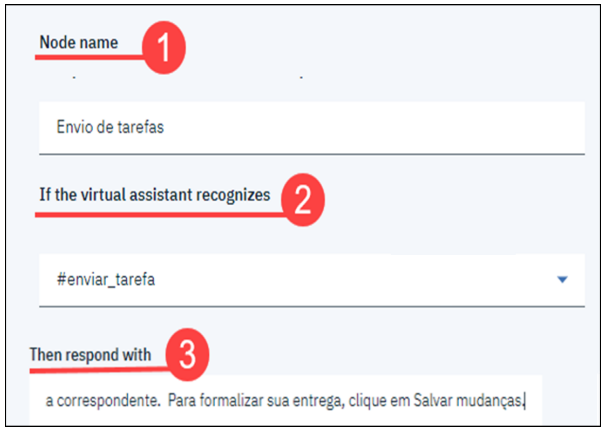

Fig. 10. Configuration of the bot's intention.

recognize a student's question or goal, such as paying an invoice, checking your balance, and so on. These goals are called "Intentions." It is necessary to store only a few examples of questions that the student can ask on a certain subject for the bot to become smarter. The training of the bot was carried out observing the closed contexts of the subjects defined in the first bot so that it was possible to repeat the questions of the conversations that did not obtain correct answers.

The next step was the creation of the question and answer scenario for the bot, called "Dialogue". In this way, the bot will learn to recognize the student's Intent, created in Step 1, and respond according to a predefined response. The last step in training the bot is to wait for the time for processing the training, which will depend on the amount of the "Dialogue" created. At the end, the bot can already be tested. Fig. 9 shows the step of creating the bot.

Fig. 10 shows the configuration panel of the intentions that the bot was trained to recognize. In item 1, I display the name assigned to the node related to the created context. Item 2 shows an intention created, below, in item 3 is shown some examples of possible questions of the students.

Fig. 11 shows the configuration of a dialog that consists of relating an intent to a possible bot response.

Fig. 11. Configuration of the response of the bot.

Fig. 12 shows the intentions and responses created in the dialogue. At this stage the bot was trained. At the end the bot is ready to be used.

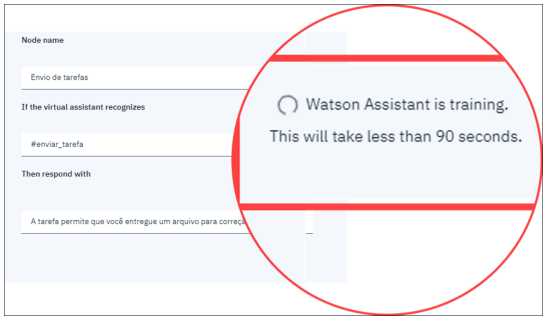

Fig. 12. Bot training.

IV. RESULTS AND DISCUSSIONS

In order to test the ability to understand and identify the student's intention and provide an adequate response, the questions not previously answered (see table III) by the first bot were submitted to the new bot. The bot used the Facebook Messenger interface and was integrated into AVA Moodle for testing. The result of the interaction is shown in Fig. 13. The question asked: 1 - "how do I enroll in a course for the first time" is submitted. Then the bot identifies the student's intention: 2- "#Disciplines" and returns with the answer, 3, corresponding:

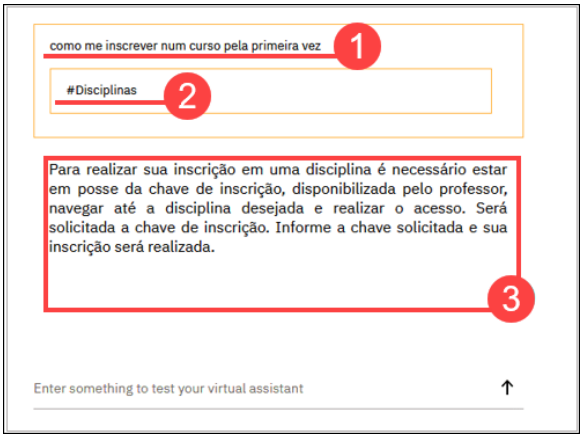

Fig. 13. Recognition bot panel.

Fig. 14 below shows the interaction of the bot created with the student using the Facebook Messenger interface.

In the tests performed, the bot is able to respond adequately to those questions not previously answered by the first bot. At the end of the interactions with the bot, students were invited to evaluate the bot's attendance. The research followed the Net Promoter Score NPS [29] model to measure the degree of customer loyalty and satisfaction of companies of any segment. From just one question it is possible to get the level of user satisfaction. Analyzing and classifying the results, we obtained: 10 students scored between 4 and 5. These students

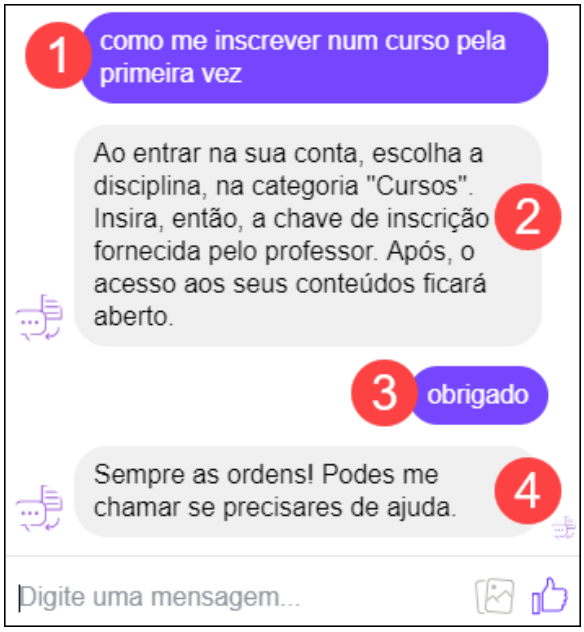

Fig. 14. Bot integrado ao Facebook Messenger: 1-pergunta; 2-inteno identificada; 3-resposta do estudante; 4-resposta do bot.

were satisfied with the attendance. And two other students were classified as neutral, they were satisfied with the service, but they did not have their expectations surpassed.

TABLE II
RESEARCH OF SATISFACTION OF USE OF CHATBOT

Rating	Level	Quantity	Ranking	%
5	Excelent	8	Promoter	67,0
4	Very good	2	Promoter	16,5
3	Good	2	Neutral	16,5
2	Reasonable	-	Detractor	0
1	Reasonable	-	Detractor	0
0	Terrible	-	Detractor	0

Twelve students responded to the survey. To obtain the level of satisfaction NPS is necessary to perform the calculation between the difference of the percentages of the Promoter and Detrator. In this case, since the Detrator index was equal to 0, then bot service was rated as excellent. The results presented demonstrated improvements in the student use experience with the increase in the quality of the interactions responses with the bot

V. CONCLUSION

This work begins with the development of a conversation bot, which uses the Watson cognitive platform to support the student on the use of AVA (Moodle).

The tests were implemented through the concepts on domain development, model and knowledge base for bots were explored in this study. A preliminary test was performed connecting the bot to the Facebook messaging service and integrating it into AVA Moodle. The tests demonstrated the

acceptable functioning of the bot in the interactions with the students, however it was realized the need to be improved in the following aspects: to increase the knowledge base in the proposed context; add regional terms; learn from interactions.

However, the flexibility of developing and customizing a one-way or multiple-purpose bot offered by NLP combined with full-time attendance is an important academic resource for the EaD student. Doubts of content, tools and processes of course activities can be met in a short period of time, optimizing student service. In future work, it is hoped to empower the bot with audio and video capabilities to cater to students with special needs.

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