

## Chatbot interaction development and assessment that assists teachers in inserting content into ITS MAZK



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### **Eliane Pozzebon**

PhD in Electrical Engineering  
Federal University of Santa Catarina, SC, Brazil  
E-mail: eliane.pozzebon@ufsc.br

### **Francielli Freitas Moro**

Master in Information and Communication Technologies  
Federal University of Santa Catarina, SC, Brazil

### **Vinicius Ferri Pereira**

Computer Engineer  
Federal University of Santa Catarina, SC, Brazil

### **Maria Paula Corrêa Angeloni**

Master in Information and Communication Technologies  
Federal University of Santa Catarina, SC, Brazil

### **ABSTRACT**

This paper aims to present the use of a chatbot as an alternative for teachers using an Intelli-gent Tutoring System and also verify MAZK's chatbot acceptance among the instructors, as this functionality was developed in MAZK's system exclusively for this purpose. A questionnaire was carried out with 32 teachers, most of them beginners on MAZK. These instructors should set up a class with the chatbot's help and it was noticeable that this resource's use in their training was well accepted due to the practicality of an online tool. Still, some of the instructors had questions if they could learn all the aspects of the system only through the chatbot's help. Teachers who had previously used MAZK considered the chat-bot's development a necessary improvement as a supporting tool.

**Keywords:** Teacher Training, Chatbot Development, Intelligent Tutoring System, MAZK.

## **1 INTRODUCTION**

There is a big discussion in the educational area regarding how to use technological devices as supporting tools for the subjects taught in the classroom in an adequate and motivational way. The use of technology has made students collaborate amongst themselves regarding the studied subjects, not only knowledge replicator listeners [1]. That way, the teachers get potentially empowered, because they have gotten devices to catch the students' attention and to share rules and experiences in the context of the matter that is being taught.

Technology's use makes the instructors turn into knowledge mediators instead of being only transmitters, hence they can present the subjects in an interdisciplinary way [2]. Brazilian Federal Government has elaborated – through the Ministry of Education (MEC) – policies to help spread the usage of New Information and Communication Technologies in public education, with projects such as "Digital Education" and "Educational Tablet" and raising capacity through programs as "PROINFO" [3].



The Department of Education of the United States highlights that it is important to create various approaches and ways to capacitate the teachers to use the technological tools, searching for the best manner to prepare the instructors to project and implement their teaching strategies. As the available resources for each school are distinct, it must be considered that the technology itself can provide an enriching role through the professional's training, whether for the knowledge's conception or its dissemination [4].

An Intelligent Tutoring System (ITS) – MAZK – has been developed utilizing Artificial Intelligence techniques for the hybrid teaching of various subjects. These systems are usually filled with texts, examples, exercises, and other learning objects provided by a specialist and accessed by students, to help the latter [5].

According to NMC Horizon Report (2018), some reports predict a 43% growth for Artificial Intelligence in the educational area until 2022 and highlight the use of chatbots to record, organize and provide detailed feedback from the students, while answering their questions [6]. The potential role of chatbots is to generate curiosity and instigate interest in a product, a process, or a problem [7]. In this context, the chatbot can perform the intermediary role between the system and the professors, helping the latter with any questions and directing them on the usage of a tutoring system, while guiding the instructors' training and supporting the understanding of the system's functionalities.

From the research that was performed with the technological resources available – resources that might contribute to the teachers' training regarding the tools used in education –, this paper aimed to evaluate a chatbot's potential implementation developed to assist instructors on the intelligent tutor MAZK.

## 2 METHODOLOGY

To build the theoretical reference that created basement for this research, the following databases were used: Scopus, IEEEExplore, ACM Library, Google Scholar, UFSC periodicals; journals such as Renote – that approach the technology and education themes, conference proceedings of important events in the educational field, physical and digital books, dissertations and theses, besides important websites in the technological area.

A data survey was performed – about using chatbots for teachers' training on intelligent tutoring systems – on the mentioned databases during the methodological procedure of this paper and no results were found for a chatbot designed with that purpose searching for the queries "chatbot" AND "training teacher", "chatbot for professor training" nor its variations. Hence no databases found chatbots meant to help teachers/tutors with an intelligent tutoring system, which characterizes innovation on the proposed research theme. However, it was possible to find many chatbots with educational intentions to assist students and chatbots used as support on websites with no educational purposes.



The search also found a methodology that checked the teachers' actions while using chatbots to help students, and it offered the instructors – according to the need – an experience where they could use the tutoring chatbot before applying it to the students [8]. These researches were used as basements for the construction of this paper.

### 3 CHATBOTS ON EDUCATION

Creating intelligent tools using Artificial Intelligence techniques has become a continuous and necessary practice in searches for improving technological procedures and there are many types of research around that topic. This paper will address conversation bots denominated chatterbots or chatbots (this second designation is more common in the development field and will be used in this work), which are computer software that simulates a conversation with people to make them believe they are talking to another person [9].

There are some possible types of chatbots [10]:

- a. Only for conversation: this type of chatbot focuses on the users' conversations and does not need to deeply understand what the user says nor to register the context, this type of chatbot is just for entertainment;
- b. Goal-oriented: helps the user accomplish tasks and obtain specific information;
- c. Goal-oriented and for conversation: presents the first two types combined in its construction.

In the 1950s, Turing proposed the imitation game where an interrogator communicates via terminal with a software and another person, that should find out who it was [11]. That created the first generation of chatbots, which is currently in its fourth generation [12].

Elektra was one of the first chatbots created in Brazil for educational purposes. She was developed in 2002 by researchers of the Federal University of Rio Grande do Sul (UFRGS) to help high school students learn Physics to prepare for University. In 2003, it got an extension for teaching computer networks that still works and can be accessed through the website (<http://penta3.ufrgs.br/~elektra/info/index.htm>). It was inspired by the ALICE chatbot [9].

Another educational chatbot was developed to be a part of the languages teaching tool Duolingo – considered an intelligent learning system –, called Duolingo bot, which offered practice classes to the students via chatbot. As the students talked to the bot, it would correct their spelling and check the learning level of the student, so it could progress in the chosen language [13]. Another example is the EASElective, a chatbot developed to assist the students with information about the course, such as characteristics of the teachers, perceptions, and other relevant aspects to help their questions [14].

Various other chatbots are developed every day and many of them have the intention of answering students' questions on a specific discipline, assisting them on different matters [15].



## 4 MAZK CHATBOT

The intelligent tutoring system MAZK was developed by the Laboratory of Computational Technologies (LabTeC) of the Federal University of Santa Catarina (UFSC) and it applies the intelligent tutoring concept using Artificial Intelligence techniques with pedagogical theories to help students with specific contents. The MAZK system is divided into two types of main users: the teachers and the students. The teacher can register questions, explanations, and examples, elaborating material that may or may not be a part of a virtual classroom and course. The students can use this material when logging on to MAZK to use it as support for their studies.

By interacting with teachers that use the intelligent tutoring system MAZK, it was possible to notice the need to create some method that would respond to common questions in a quick, clear, and intelligent way, amongst other necessary aspects for using the system. Chatbots are intelligent solutions used by several companies to chat with the clients, which facilitates the purchase and sale of various products and can be used in other areas, like education, by helping students solve their questions about certain matters. This paper presents the development of a chatbot that "helps teachers that use MAZK to create their teaching material and enjoy the system's functionalities simply and intuitively" as its main objective. To elaborate on the knowledge acquired by the bot related to MAZK, there happened an analysis of the user support manuals and the teacher and pedagogical structural models. These manuals are available in a tool in a .pdf file, containing explanations and illustrative images.

As for the manual analysis, a database was created with potential questions and their answers. It was considered some questions that could be asked to the bot, in different ways, to each functionality of the system, creating then a range of possibilities for each specific subject. The inserted personality traits were designed from the analysis of the presential training team and from the searches for the insertion of features that resemble a human, besides analyzing MAZK's graphic interface and its structural modules, respecting the software's planning and taking into consideration the system's color palette, availability, attributes, and features. For the bot to maintain a dialog, a model was created through the structure of a JSON file, to deal with the questions taking the context into account, and some chatting intentions were defined in this model. It also created a word classifier using NLTK, a Python tool block to make a natural processing machine language along the TFlearn library, a property of TensorFlow for learning processes. The classified data are transmitted to the neural network, built through TensorFlow. TensorFlow catches data and uses it to make tests, aiming to assess the precision of a newly assembled model, until it gets to a satisfactory knowledge level. It was decided to use the simple deep learning network because that network model has the characteristics to process a big number of data for the output of a smaller set. This was possible to notice because of the following: the network input document has a big number of data, synthesized by the NLP classifier from MAZK's



manual. The outputs are the "classification tags", to which the questions and answers belong. To enter the words "good morning", for example, the network verifies which tag has a heavier weight related to those words, and uses that information to return an answer.

By completing the tool programming and the network training, it was possible to verify the bot's learning. The chatbot replied, in an autonomous way, to questions that were made according to the studied basis, showing intelligence by distinguishing questions asking for examples and questions about creating virtual classrooms, for example.

#### 4.1 DEVELOPMENT PROCEDURES

To build the chatbot, it was necessary to search for development alternatives until it was decided to use the programming language Python in its 3.6.5 version. Besides, it was also decided that Artificial Intelligence techniques would be used, such as artificial neural networks and machine processing language with libraries previously developed, like TensorFlow, TFLearn, and Natural Language Toolkit (NLTK). MAZK is developed on Hypertext Preprocessor (PHP), which means it is necessary to find alternatives to integrate its system with the chatbot. Studying MAZK and its manuals was also necessary for creating the bot's database. Table 1 shows the development methods.

Table 1. Development Procedures.

Conception	Development	Integration
Problem analysis	Learning the Python language and the TensorFlow, TFLearn, and NLTK libraries	Learning how to integrate Python and PHP
MAZK manuals analysis	Learning about the operations of neural networks and natural machine learning in practice	Chatbot insertion and tests on the MAZK system, considering its problems
Database creation with possible questions and answers	Development of JSON file with answers	Creating the bot's graphic interface
Analysis and creation of the bot's personality	Development in Python 3.6 on Sublime interface using concepts and libraries to build the bot's structure	Making it available for tests

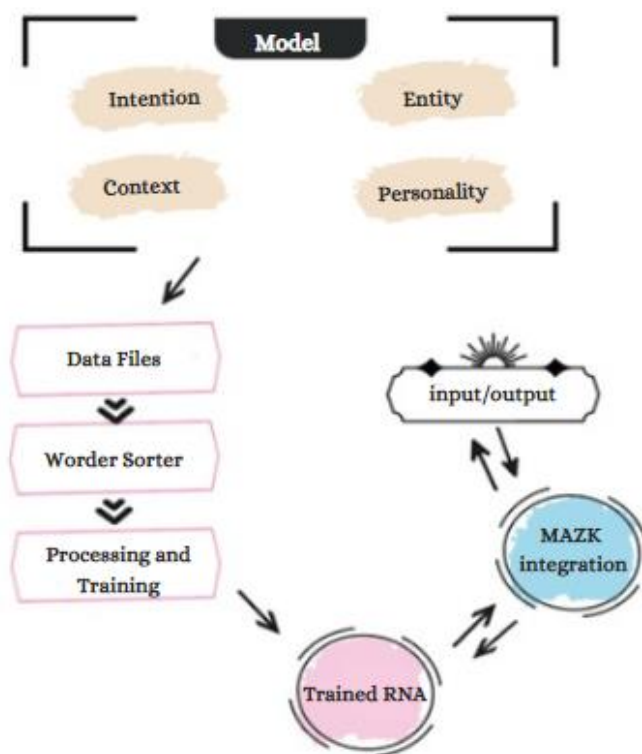
The chatbot structure corresponds to the following aspects, from the interaction with other bots, through the gathering of characteristics present in its construction:

- Intentions: what the bot intends to respond;
- Entity: the necessary components for the response;
- Context: the situation in which the response is inserted;
- Interface: the project of the interaction with the human and the construction of its personality.



Figure 1 shows the modeling of the chatbot structure, where it was defined its intentions, entities, personality, and context. With that, it is possible to create the database through a data file that goes through the word classifier and procedures and data training on the network until it gets available for input interaction and output responses with the user.

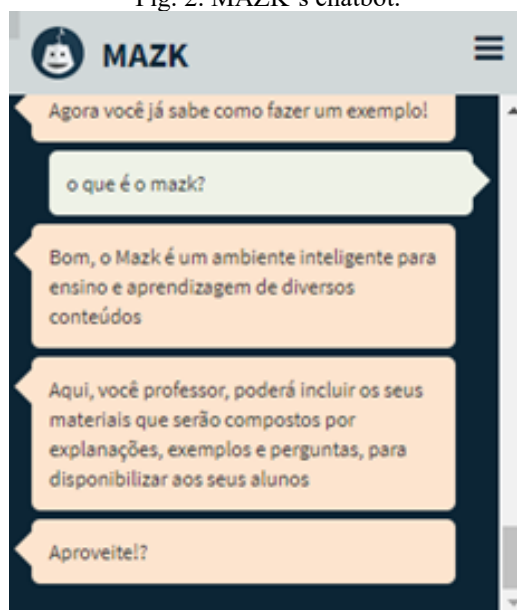
Fig. 1. MAZK's chatbot structure.



With the integrated chatbot, it was necessary to perform utilization tests to observe aspects regarding the usability, as well as how to make improvements to present it to the users and how to change the bot's internal structure, for it to be available for the teachers users. Most of the errors and possible improvements noticed in the first tests were solved with new training and changes in the PHP script for the chat presentation for the users. From the chatbot interaction with 32 teachers, it was possible to observe and evaluate heuristics for improvements by checking the aspects related to usability, safety, ethics, visibility, and communication, suggesting some changes for the chatbot's effectiveness and posterior applications. This paper is a part of one of the author's master's degree research, with updates about the tool's evaluation regarding a human-computer interface analysis of the developed object. The chatbot developed for MAZK is only for conversation, but a new version is already being developed with updates that allow a mixed approach, as it is shown in Figure 2.



Fig. 2. MAZK's chatbot.



## 5 APPLICATION WITH TEACHERS AND RESULTS

To evaluate the acceptance of the developed chatbot and verify the potential of its implantation, a questionnaire was elaborated and made available online. This questionnaire had 15 questions of which 3 of them are presented in this paper, as they are directly connected to the chatbot's potential evaluation made by the teachers. The questionnaire was answered by 32 users that teach at public and particular schools, and other kinds of institutions in the south region of Santa Catarina. These users were supposed to build a classroom with complete material with the chatbot helping them and clarifying any possible questions about the system's usage.

To find out the users' knowledge level about the tool, they were asked if they had previously used the Intelligent Tutoring System MAZK. Also, the type of questions the teachers asked the chatbot was noted to check and see where it would be able to assist them and if it could help with the more advanced questions related to the system. Most of the respondents said that had never used the system before, and only eight users said they had used MAZK somehow before.

The respondents that answered they had already used MAZK before received the following affirmation: "I consider the addition of a chatbot a facilitating instrument in the process of understanding the MAZK tools", and then the teachers could agree or disagree about the topic.





Fig. 3. Opinions on MAZK's chatbot inclusion on the system.

**I consider the addition of a chatbot a facilitating instrument in the process of understanding the MAZK tools**

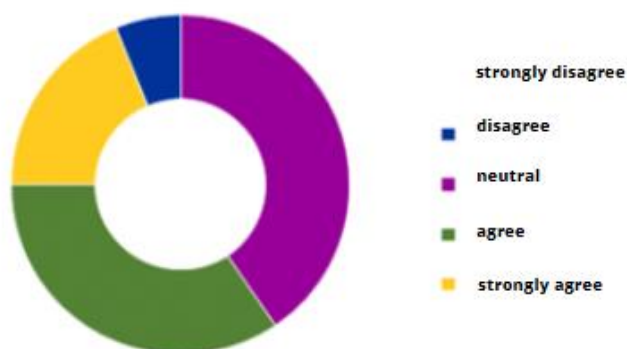


As shown in Figure 3, almost all teachers that had previously used MAZK considered that the inclusion of a chatbot was a facilitating instrument in the process of understanding and none of them disagrees, which makes it possible to say it was a positive aspect. One of the teachers reported that if this resource was available when he first used the system, it would have been easier for him to understand the procedures on the tool and it would have him time by not having to look it up in the manual.

For the other teachers, it was asked their opinion about the exclusive use of the chatbot to assist them while using the system, if they thought it was viable, or if they needed something else to help them, besides the chatbot. This question is related to chatbot use and is especially important for long-distance instructors, and is also related to understanding the procedure the teacher has over the tool.

Fig. 4. Chatbot's usage.

**Would you be able to use MAZK having only the chatbot's assistance?**



As shown in figure 4, there was a significant quantity of teachers that had doubts about using or not the chatbot as the only way to have any assistance in the system. It was possible to notice that the teachers that had more trouble with technology and basic computing details would have difficulties





using the chatbot, especially if it does not respond to questions like copy and paste, copy link, etc. It is important to understand that having a data limit to which the bot can respond is fundamental for interaction. This is one of the most important questions to analyze because it is possible to observe that with short-term questions are important in the MAZK system usage: the chatbot works fine, but technical support is essential to break barriers, especially because of the fear of dealing with new technologies. The chatbot is a technology used by many companies that answer preprogrammed questions: understanding the context is the biggest challenge in Artificial Intelligence, and that varies according to the difficulties of each teacher.

With the questionnaire's answers and through observation, it was possible to build Table 2 with the principal suggestions and changes to be made on a second version by the MAZK tool development team, after the confirmation of the bot's efficiency.

Table 2. Development Procedures.

Problems	Solutions
Answer questions correctly beyond the manual; or about basic computing for usage	Increase the database with questions and answers and include external usage functions in the manuals; train the network with the questions saved in the database (and create the answers)
Not answering questions without being sure	Search accuracy and return to the user a message that says the bot does not know such subject in case it is not up to a percentage
Improve the way the answers are available to ease comprehension; decrease the number of texts	Insert images, videos and suggest questions to interact in the best way with reading and entertainment
Decrease answering time	Improve network
Comprehension about how to use the chatbot, clarifying what it is and how it works	Insert in the MAZK tool or in the chatbot itself the right way to use a chatbot, whether through video or text

From the application, it is possible to consider that the chatbot is a tool accepted amongst the teachers and that it can contribute to the understanding process, assisting in the teachers' learning process regarding the technology itself. Bibliographical research was performed for the contextualization of this work, to find literature about the historical and conceptual evolution of the learning environments focusing on chatbots – the tool chosen to resolve the main issue in the research, considering that no results were found regarding chatbots assisting teachers on ITS, only students. It



is also possible to verify that researches related to chatbots in education are a tendency that has been explored more, especially in the last year, which marks an innovation to the proposed theme.

When the chatbot was integrated into the system, it was necessary to analyze if it was according to the teachers' needs and fit in the role it was supposed to. Hence, a questionnaire was available for 32 teachers, that had the aim to create a classroom on MAZK using the chatbot to help them. Most teachers considered the chatbot a tool that contributes to the understanding of the system, even though some of them had questions about whether they would be able to use MAZK just with the chatbot's assistance. This may have occurred because of the questions the chatbot was unable to answer since it was not present in the data file that the tool was trained with.

Using an intelligent tool to help the teachers' comprehension in a system like MAZK contributes to education, as it facilitates the process of exchange between the user and the system and it decreases the quantity of errors that might happen, however, the way of using the tools must be clear. In the chatbot's case, even though it works as a support for most teachers, it does not get 100% of satisfaction, whether it may be for issues that yet have to be solved or the teachers' misunderstanding. And because of that, it is necessary to do more research to be possible to study how to improve the tools to break barriers and make them useful for more users.

## 6 CONCLUSION

From the application, it is possible to consider that the chatbot is a tool accepted amongst the teachers and that it can contribute to the understanding process, assisting in the teachers' learning process regarding the technology itself. Bibliographical research was performed for the contextualization of this work, to find literature about the historical and conceptual evolution of the learning environments focusing on chatbots – the tool chosen to resolve the main issue in the research –, considering that no results were found regarding chatbots assisting teachers on ITS, only students – which is understandable, as MAZK's main characteristic is the focus on content teachers, and that is not common on most tutoring systems. It is also possible to verify that researches related to chatbots in education are a tendency that has been explored more, especially in the last year, which marks an innovation to the proposed theme.

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