Building a chatbot for student support

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Abstract

Online distance education has received a lot of attention lately, due to the Covid-19 pandemic. However, most students are not familiar with its pedagogical approaches, need for autonomous studying, modes of assessment, and also administrative services, that mostly function online. In this context, students generally need an initial support that some institutions provide in the form of a bootcamp course/module. As most of the doubts of the new students are the same, in this paper we propose to introduce an automated chatbot that directly answers those common questions that students have when they start to attend an online university. The bot was provided to students in the bootcamp module, complementing the role of the (human) module monitor. After assessing student feedback, we obtain encouraging results, that point to the convenience of using an automated chatbot for directly answering frequently asked questions and to provide initial support.

Keywords: chatbot, artificial intelligence, online student support, frequently asked questions, design science research.

Título: Construção de um chatbot para apoio ao estudante

Resumo: A educação a distância online tem recebido muita atenção ultimamente, devido à pandemia de Covid-19. No entanto, a maioria dos alunos desconhece as suas abordagens pedagógicas, a necessidade de estudo autónomo, os modos de avaliação e também os serviços administrativos, que funcionam principalmente online. Neste contexto, os alunos geralmente precisam de um suporte inicial que algumas instituições fornecem na forma de um curso / módulo de bootcamp. Como a maioria das dúvidas dos novos alunos são as mesmas, neste artigo propomos apresentar um chatbot automatizado que responda diretamente às dúvidas comuns que os alunos têm quando começam a frequentar uma universidade online. O bot foi fornecido aos alunos no módulo bootcamp, complementando a função do monitor do módulo (humano). Após avaliar o feedback dos alunos, obtemos resultados encorajadores, que apontam para a conveniência de usar um chatbot automatizado para responder diretamente às perguntas mais frequentes e para fornecer suporte inicial.

Palavras-chave: chatbot, inteligência artificial, apoio online ao estudante, perguntas frequentes, investigação em design science

1   Introduction

Artificial Intelligence has become an inevitable part of ecommerce, oil industries, medical field, education and so on. Society has become aware of the power of AI, and it is increasingly important to teach and learn about it at several levels. To make AI more accessible and understandable it is always good to start educating students about it. In order to appreciate the benefits of AI, students and their teachers can be given an opportunity to interact with AI [1] and to build simple AI tools.

Nowadays, a chatbot can be built with cloud services provided by major companies (Microsoft, IBM, Google), without having to know the details of specific AI algorithms or techniques. The learning curve is soft, and several integration options are available within the tools.

The main advantage of a chatbot is that it is available 24/7 to provide the necessary support required for the students. Another advantage is the low cost in implementing such a chatbot, as its free version is readily available and coding knowledge is not required in setting up a basic model of the chatbot. Advanced machine learning techniques are used in IBM Watson, which makes it one of the most effective tools to help students in school and beyond [2].

In this paper we report on a preliminary study on building a chatbot with IBM Watson to provide automated initial support to students of an online university and increase interaction.

2   Related work

There are lot of chatbots already available which are tailored to achieve specific purposes. Some bots like Medbot [7] are developed to help patients and guide them. While there are other bots implemented in the field of health like the FAQ bot developed during the outbreak of the pandemic to help patients understand whether they have Covid-19 symptoms. Certain bots like YPA [8] were developed to help with the business by guiding customers and retrieve the information the users require.

In the field of education, several chatbots like Ms Lindquist, Jill Watson and FIT-eBOT [5] were developed as tutoring bots to help students with tutoring and provide support in their learning modules [6]. Chatbot created by Carayannopoulos and CiSA [9] were designed mainly to answer students frequently asked questions but these bots were implemented in instant messaging (IM) platforms like KiK messenger and Facebook.

Even though these chatbots are already developed and looks very similar to the one we are proposing, we focus on providing initial support to students by answering their frequently asked questions (FAQs). This is achieved by designing a FAQ bot using IBM Watson which already has inbuilt natural language processing and certain other features that enables easy implementations. The main difference of our proposal with the existing bots is that, we are implementing it within the eLearning platform itself unlike IM platforms like other chatbots discussed in the above section. This feature of UAbot helps the students to find answers to their FAQs within the eLearning environment

itself. While in other bots, students must use Facebook messenger or such platforms and have an account in it to clarify their doubts.

3   Methodology

The methodology used to develop a chatbot as part of this research is based on Design Science Research Methodology (DSRM). This methodology helps to create and evaluate IT artifacts which are intended to solve the problems identified within the organization. These artifacts are then represented in a structured form [3].

Data collection is performed using the Survey research method. It is defined as "the collection of information from a sample of individuals through their responses to questions". Data processing and analyzing are performed by qualitative analysis. Qualitative research is development of concepts which help us to understand social phenomena in natural (rather than experimental) settings, giving due emphasis to the meanings, experiences and views of the participants [4].

For this study, we applied DSRM with an artifact called UAbot, in the context of initial attendance of students of an online university. The goal was to assess the usefulness of first-time online students' interaction with an automated chatbot. The evaluation was performed by conducting surveys and analyzing, quantitatively and qualitatively, its results. A second round of surveys was performed after integrating the results of the first, corresponding to a second iteration of DSRM.

4   UAbot: a chatbot for initial student support

The "UAbot" chatbot is developed to be a conversational bot to interact with the news students in bachelors' courses of an online university. This chatbot was implemented in the *Módulo de Ambientação Online* (MAO - bootcamp training module), as this module gives an insight about the functioning of UAb, its learning and assessment model, location and schedule of exams, enrolments and certificates.

The architecture of the system developed includes 4 main components (Fig. 1). To develop UAbot and integrate it into the institution's Learning Management System (LMS), a phase of analysis and preparation is required. First step in creating UAbot is defining the goals that need to be achieved by the bot: in this case, the main goal is to provide initial support to the students by answering Frequently Asked Questions (FAQs).
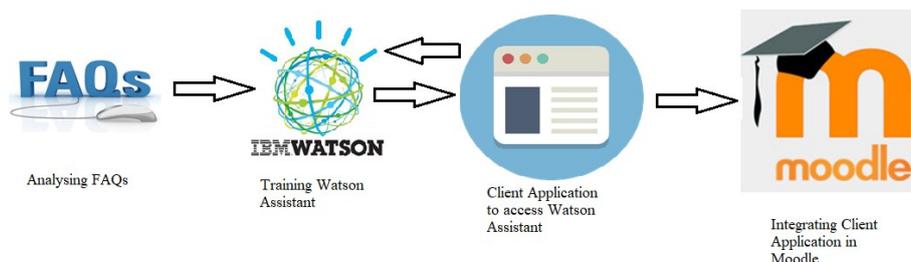

Fig. 1. Architecture of UAbot development

To train the bot to answer FAQs, a list of previously asked questions needs to be analyzed. Based on the analysis, the final data to train the chatbot is defined. Once the data is finalized, IBM Watson Assistant needs to be fed with all the data with the corresponding responses. Then the bot created needs to be tested and trained to fine tune the results.

A client application is then created to communicate with the conversational agent. It is developed to provide a user interface for the students to send their queries and receive the responses. Once the client application is ready, then it needs to be integrated into the LMS. This integration makes it easier for the students to use the UAbot within their learning environment.

The development of the bot itself in IBM Watson consists of two phases: definition of intents and dialog tree creation.

An intent corresponds to the intention of the users interacting with the chatbot. It is defined for each type of request the application supports. Alexa, Dialog flow, Watson and so on have NLP engines that require different ways to phrase an intent to work accurately to understand the users' request. Watson prefers at least 5 examples for each intent to get best results.
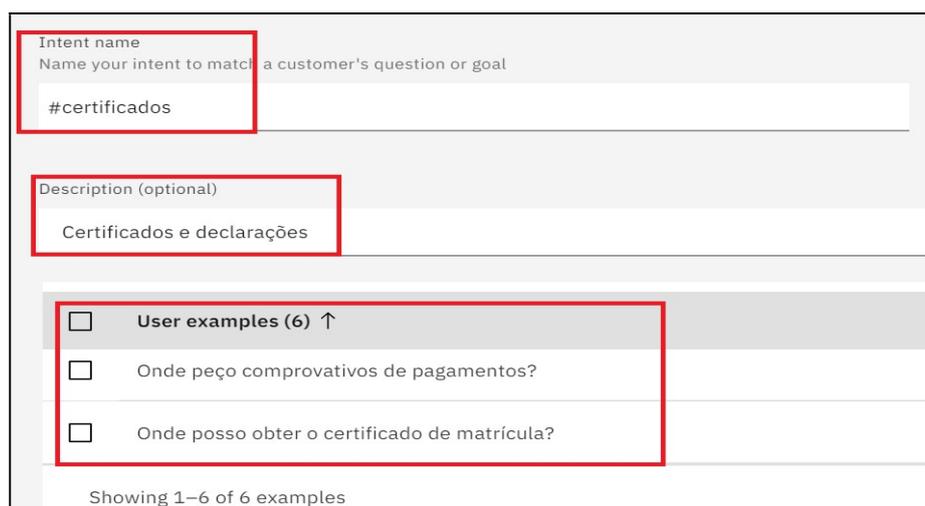
Fig. 2. Creating an intent #certificados and providing 6 examples

Intents are identified by thoroughly analyzing the FAQ list provided by the MAO team. The main keywords are identified and added to the intent by providing 5 examples for each intent. Figure 2 shows one such keyword identified, and an intent is created which is named as "certificados" (certificates). Likewise, 21 intents are added in UAbot with more than or equal to 5 examples. The screenshot of the intents created is shown in figure 3.

Fig. 3. Intents used in UAbot

Fig. 4. Dialog created for the intent "certificados"

A dialog defines the flow of the conversation and the response of the chatbot according to the intents identified. For each intent, a dialog branch is created in order to provide the corresponding response. The nodes in the dialog tree are triggered based on the user input. A dialog tree is created by inserting conditions and specifying appropriate responses for each intent identified as shown in figure 4. During first iteration of the study, 23 dialog nodes were created in the dialog tree and 35 dialog nodes during second iteration.

Dialog tree created for UAbot has included the intents identified and corresponding responses are fed for each intent. A part of the dialog tree is shown in figure 5.
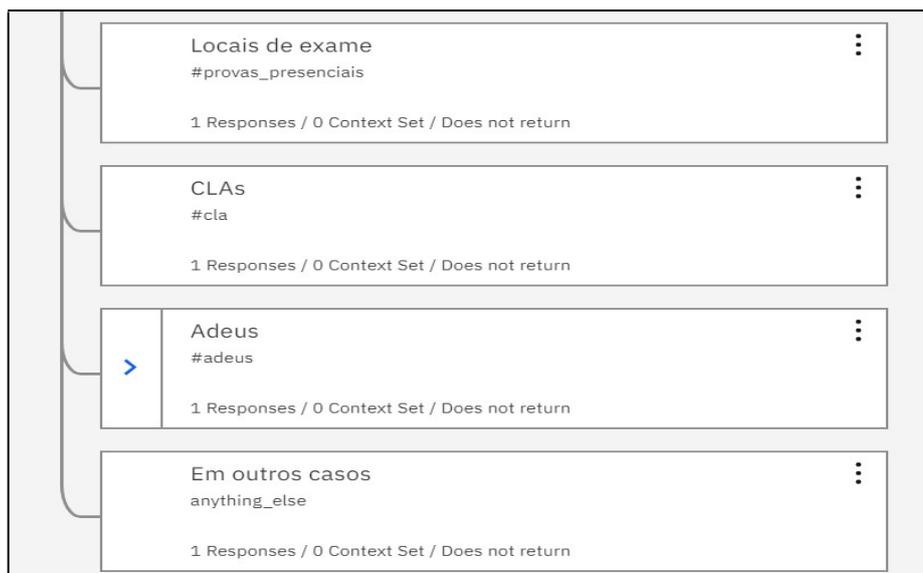
Fig. 5. A part of the dialog tree used in UAbot

The dialog tree has nodes which are categorized as follows:

- *Introduction*: This section includes an introduction about the purpose of UAbot and the areas in which the bot can help the students. The details stored in this node are displayed immediately after the user opens the bot, which is basically the first interaction with the user.

- *Greetings*: This part of the dialog tree greets the user when the user starts the conversation with a greeting which includes "hi", "good morning", and so on, chosen randomly. The bot responds by asking how it can help the user.

- *Queries*: In this section, the response to all the intents created are specified. Each intent corresponds to the queries of the users. The answer to each query is different and it is specified in the dialog tree. These answers can be sentences which is a direct reply to the students' query. The answer can also be either a link to a page with more details for students' reference, or an image with more explanation.

- *Exceptional Case*: This node in the dialog tree is created to provide response to user when the query doesn't match any other nodes. In this node, it asks the user to rephrase the question as the bot doesn't understand the users' query.

- *Feedback*: This section of the dialog tree is used to gather the feedback in 5 point Likert scale from the user at the end of the conversation, where 1 corresponds to "strongly dissatisfied" and 5 being "strongly satisfied". Once the user specifies the feedback, the bot says bye and wishes a good day.

5   Surveys and Findings

After the chatbot was developed and integrated in the LMS, it was made available for the students to access it. To collect the feedback from the users (students), an online survey was prepared with questions to analyze different criteria like usefulness and interaction, with possible answers organized in a 5-point Likert scale. The survey also had questions to understand the user satisfaction and to collect additional comments to improve the chatbot. Main motive of the survey was to understand whether the chatbot has met the expectations of the users and to improve it with the necessary changes.

During the second iteration, UAbot was improved and integrated into the coordination course of computer science. 43 students responded to a new survey, providing their feedback.

The surveys were conducted using Google Forms and the link to the survey was provided in the courses in which UAbot was integrated. The main intention of the surveys was to collect students' feedback and suggestions after using the assistant.

The surveys were composed of 10 questions which needs to be answered in 5-point Likert Scale. Those questions were framed to capture feedback about learnability, usefulness, simplicity and interaction as shown in table 1. In addition to the 10 questions, we included two more questions: one to record the number of questions the users had to ask the bot, in order to receive the adequate response, and the other to capture their comments to improve or change the artefact.

Table 1: Questions in the survey categorized based on the aspects

Aspects Checked	Questions
Learnability	Do you have to learn a lot of things to understand how to use the chatbot?
Simplicity	Was the chatbot easy to use?
Usefulness	1. Did the chatbot gave you the initial support to understand the functions of UAb? 2. Did the assistant answer your queries correctly? 3. Was the chatbot useful in answering your queries than looking for answers in FAQ list? 4. Was the chatbot useful in finding answers for your questions?
Interaction	1. Do you like interacting with the assistant? 2. Do you like to continue to use the assistant after MAO?
Satisfaction	1. Would you recommend this assistant to your colleagues in UAb? 2. Are you satisfied with the overall performance of the assistant?

In the first iteration, by analyzing the feedback from 60 students that answered the survey (see figure 6), we understood that they like the chatbot and they are satisfied with its response to their questions. The students agree that it is easy to use and they prefer to use it even after the bootcamp module ends. They even assured to recommend

this chatbot to their friends. They were able to find answers to their questions using UAbot.
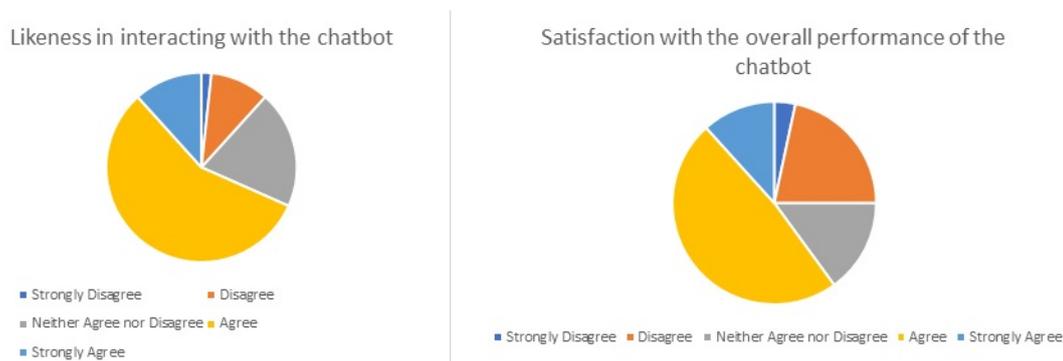

Fig. 6: Results of the survey to the students using UAbot

But the students had a neutral response about the chatbot's help in finding answers to the frequently asked questions. Equal number of students agreed and disagreed that UAbot can provide the initial support for the students regarding the functioning of the university. Responses from the users point to the fact that it is an initial version of the chatbot and requires lot of improvement to perform well and according to the expectation of the users.

After proper analysis of the survey results, and also the chatbot logs, the artifact was modified so that it was able to answer more wrongly answered questions correctly. Figure 7 shows log results after analyzing the questions based on different categories during the first iteration. Database of the chatbot was extended to include details about UAb, library, payments and so on. The corresponding answers were also fed in the dialog tree for these identified questions.
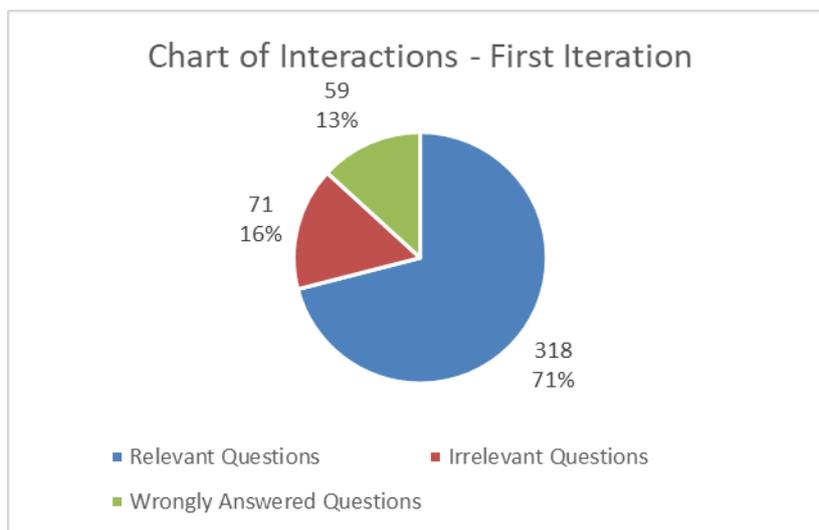

Fig. 1. Chart displaying log details of questions asked by students in first iteration

After the modification on the chatbot database, UAbot had 33 intents and 35 dialog nodes. As a result, the bot was able to communicate more effectively compared to the first iteration. Wrongly answered questions were included into the database of the bot, which were added as intents in IBM Watson Assistant. The responses to these questions were added in IBM Watson Assistant in the dialog tree which now has 35 nodes. Figure

7.4 shows the details about the UAbot modified after first iteration. This bot was used during the second iteration.

We then compared the answers to both iterations. Analyzing figure 8 for the percentile agreed on different aspects we can find that almost all the aspects had a score increase in the second iteration except in 3 scenarios. First one being the learnability. In learnability, we are checking whether the students need to learn about how to use the bot before using it in the online module. Analyzing the percentile agreed, we understand that learnability has decreased tremendously during the second iteration compared to the response during the first iteration, which is a great improvement. This indicates that the students agree that they don't need additional guidelines or information to use UAbot.

Second question which didn't had an increase in the second iteration is regarding usefulness and the question was whether the chatbot was able to answer their questions correctly. As it is a bot, there is a general tendency to expect that it would answer for all the questions the students have. As a result, the expectations from the users are too high. But in UAbot, our main focus was just FAQs. The users' opinion was generally distributed with neutral and negative opinion due to this high expectation.

The last question which had a contradictory response was in the question which was used to check the interaction. The question was checking with users whether they would like to continue to use UAbot after MAO. UAbot was mainly focusing only on FAQs which the users have during the initial days. As they complete MAO, they will be familiarized with the functions of UAb and the pedagogical model. As a result, students' opinion can vary from each student depending upon how familiarized they get with the functions of UAb.

Except these three questions mentioned above, there was considerable improvement in the results after the second iteration compared to the results, we obtained during the first iteration as shown in figure 8.
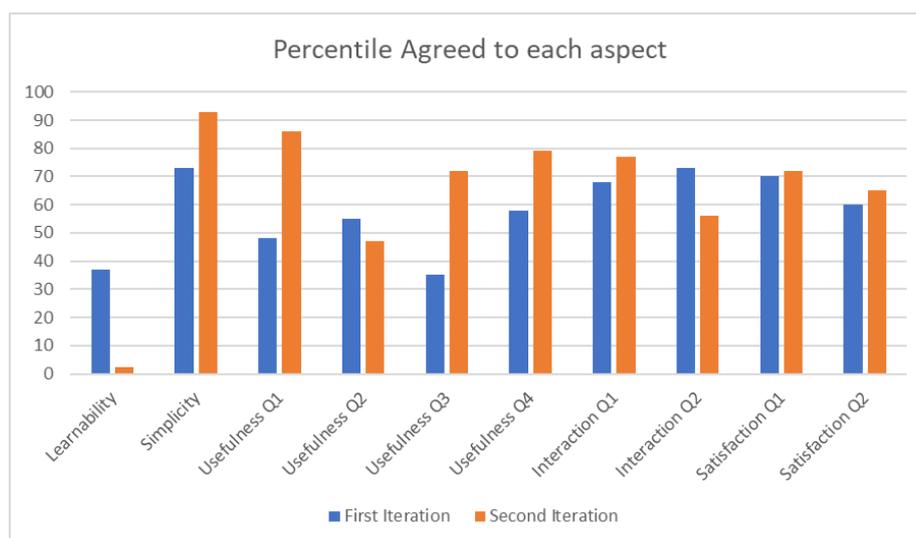

Fig. 8. Percentile Agreed by students to the aspects checked

The log was analyzed again to find more details about the list of questions asked by students. These questions were then categorized to relevant questions, irrelevant questions and wrongly answered questions. The log results are analyzed to find whether

there is an improvement in the bot. We found that wrongly answered questions has reduced from 13% in first iteration to 2% in second iteration which is a great improvement. Analyzing the results about relevant questions, it was found out that during first iteration 71% questions were relevant questions. While in second iteration, relevant questions have increased to 73% as shown in figure 9. After closely examining these logs, we can conclude that the changes made after the first iteration has helped UAbot to perform better in answering more questions correctly. Reduction in wrongly answered questions points to the fact that UAbot was able to retrieve available data from database to answer almost all relevant questions.
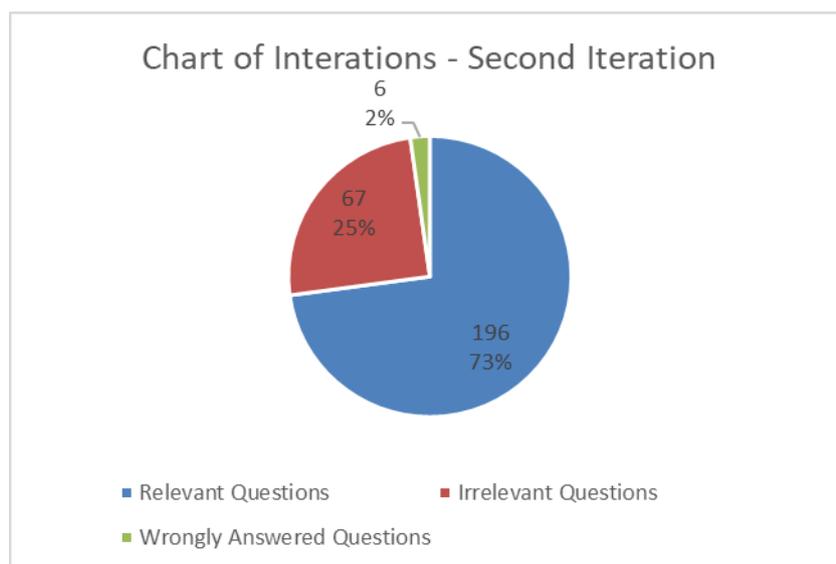

Fig. 2. Log details of questions asked by students in second iteration

6   Conclusions and future work

A chatbot is an easy-to-build alternative to FAQ lists, which students appreciate interacting with. The process of building the bot is easy enough so that it can be taught in non-technical courses, without the need for coding.

We believe that building some AI agents, like chatbots, is not anymore a task for programmers, since no coding is necessary to use the cloud services provided by these major companies. However, an understanding of how AI and machine learning works is useful, stressing the importance of examples and (machine) training processes, and introducing these concepts in general curricula seems a good way to create student's eagerness for AI use and development early on.

We have successfully integrated a chatbot into the eLearning environment of an online university to help students in their initial days at the university. The students will have lot of questions about the functioning of the university, pedagogical model and so on. The aim of the chatbot is to provide more interactive support to distance learning students to find answers to their FAQs. The main appeal of a bot is that it is instantly available 24/7 to provide support to students 365 days irrespective of the time zone the student is.

One of the main research questions was to check whether the chatbot was useful for online students in providing them the initial support required. Experiments were carried out with students and their feedback was recorded using surveys. Based on the analysis of the data derived from the experiments, we can conclude that UAbot integrated into the LMS is useful in providing initial support. Even the expert users agreed that the UAbot can provide the initial support required for the students.

Another objective of this work was to answer students' frequently asked question in an interactive way. The frequently asked questions were added into the database of IBM Watson Assistant which was then integrated into the eLearning environment to provide access to students. This helped the students to have access to UAbot to find answers for their FAQs. After analyzing the feedback from students and expert users, we can confirm that UAbot provided an interactive way to find answers to FAQs.

UAbot is just an initial version of creating a bot to answer students' FAQs and requires a lot of improvement in different areas to have the performance of a commercial chatbot which we can see in certain sites. A bot can perform well only if it is updated on a day-to-day basis with the latest details available.

Thus, the main future work for this bot is to incorporate the suggestions of the students who have used UAbot. Students suggested that they prefer UAbot to be incorporated as a popup at the bottom of the page to facilitate usability. As answers for certain queries links were provided so that students can find a detailed answer for their question. Once the link is clicked it is opened on the same chat window. But students prefer to have the link opened in a new page. One of the main suggestions from the students was to provide an option to contact a human tutor within the chat window itself in case it doesn't have the right answer for the students' query.

The bot can also be modified so that it will be able to communicate to students in multiple languages with an option to choose the language in the beginning of the communication.

Another line of exploration is to improve the bot so that it is more flexible and adaptable to individual students, by using specialized data and artificial intelligence/machine learning techniques.

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