

## DESIGN AND IMPLEMENTATION OF A CHATBOT IN ONLINE HIGHER EDUCATION SETTINGS

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### ABSTRACT

*Chatbots in education are in the beginning stage of development and implementation. In this study, a pilot chatbot to answer Frequently Asked Questions (FAQs) of the syllabus of an online course was created and implemented. Data was collected from graduate students and faculty to improve the chatbot and offer a fully developed chatbot that can be used in the online course to enhance students experience. The development process is presented and future directions of the implementation of the bot are discussed.*

**Keywords:** Chatbots, Interactive Conversation, and Bots in Education

### INTRODUCTION

Chatbots, also known as chabots or chatterbots (Murad, Passero, Francese, & Tortora, 2017), are being used today to help users with everyday activities. A chatbot is a computer program that, through a text or audio conversation, provides information or services to its users (Fichter & Wisniewski, 2017). They interact utilizing human friendly terminology and provide support with diverse activities any time. For example, in a typical day, we can see people interacting with voice-operated chatbots, such as Alexa or Siri, asking them a question or asking them to perform an action. In addition to the voice-operated chatbots, the text-based chatbots are found in websites helping users with tasks, such as answering a question, finding a product, or assisting with a reservation, to mention a few. These programs are running continuously, and the conversations between software and users are automated and personalized (Han, 2017).

A bot can be defined as “a computer program that is persistent, autonomous, and reactive” (as cited in Tsvetkova, Garcia-Gavilanes, Floridi, & Yasseri, 2017, p. 1). Although bots don’t have emotions or creativity, they use friendly terminology and can make decisions without the developer’s intervention (2017). Since bots run unceasingly, people find useful the fact that they can initiate a conversation and feedback will be given immediately. As Arcand (2017) discusses, users have a great experience while meeting their needs effectively, thus generating a positive emotional sentiment. The speed of resolution and ease of use is attractive because people like prompt answers to their questions, instead of having the need to navigate the web looking for information through an entire site. For example, information can be organized and presented to the user as a list of Frequently Asked Questions (FAQs). However, Shaw (2013) noted that complex information generates a large number of FAQs and “the larger the list of questions gets, the less likely a user is to read through the list adequately in order to find an answer to a question in which the user is interested” (p. 11). Consequently, the process becomes inefficient and less interactive if users need to open links one-by-one to explore the information (Pradana, Goh, & Kumar, 2018).

As a productivity tool, a chatbot facilitates the interaction between users and information in a form of a friendly conversation (Han, 2017). In order to simulate conversations, chatbots use two different approaches: rule-based bots and machine learning-based bots. In the rule-based approach, the chatbot responds to specific commands by using a documental retrieval system, where it identifies keywords and finds the response based on rules and the limited information on which the bot was trained on (Kharchenko, 2017; Pelz-Sharpe, 2017) This approach works well when the chatbot is able to recognize keywords. However, chatbot’s capabilities are limited, because it “is not efficient in answering questions whose patterns do not match with the rules on which the bot is trained” (Shridhar, 2017, para.4). Bots using the machine learning approach are based on artificial intelligence. They use Natural Language Processing (NLP) to be continuously learning in order to understand not only keywords, but human language (Kharchenko, 2017). Pelz-Sharpe (2017) argues that “the basic chatbot with limited rules and a product catalog is a neat function and hardly cause for concern. The chatbots that use artificial intelligence and machine

learning technology raise bigger questions” (p. 21). Therefore, chatbots using AI are considered more efficient than rule-based chatbots, but the latter are easier to develop than those based on artificial intelligence.

Chatbots are designed to always respond in a patient, honest, and friendly way, no matter the number of times the same question is asked, the number of users using the bot, or even rude users interacting with it (McNeal & Newyear, 2013; Fichter & Wisniewski, 2017). In the interaction process, “the chatbot takes input from a user and produces outputs that usually attempt to be conversational in nature” (Shaw, 2013, p. 11). From the user’s input, the bot looks for keywords or specific phrases and match the keyword with an answer for the inquiry, thus creating a question-and-answer dialogue. If no matches are found, the program replies using a generic response developed by the bot programmer (Shaw, 2013; McNeal & Newyear, 2013). However, since chatbots “can’t pick up on nuances in conversation that fall outside their rules-based logic” (Arcand, 2017, p. 4), it is difficult for the programmer to develop, for example, responses for sarcastic comments or slang. This is part of the complexity of developing a chatbot. The words and dialogues used come from the programmer, but users could ask questions that were not considered, thus creating confusion with the generic responses from the bot (Shaw, 2013). Waxer (2016) notes that the best way to develop a bot is not only with the programmers input, but by considering the contribution of the stakeholders and final users.

The creation of a bot supports jobs where workers perform repetitive customer service tasks such as, answering questions or helping users with updates, thus generating time for workers to perform other activities. According to Waxer (2016), chatbots are a feasible option because they can be developed “in about one-fourth the time it takes to build a standard mobile app” (p. 9), and “they’re approximately 50% cheaper to build and maintain” (p. 10). Chatbots are then a good example of how technology can be used as a way to save significant time while improving productivity. Han (2017) remarks that chatbots can be used to perform tasks such as, providing reminders, introducing new concepts, FAQ or customer service support, and new employee’s training.

Chatbots can be found in spaces where online users spend more time, spaces such as text or mobile messengers and websites (Fichter & Wisniewski, 2017; Skerrett, 2017). Part of its advantages are that communication with users is available 24/7 and users can interact with bots at their own convenience, usually in an anonymous way. Also, the process of answering questions is fast and easy, and links to diverse internal and external resources can be added (McNeal & Newyear, 2013). These features make chatbots convenient and attractive for final users. On the other hand, Skerrett (2017) argues that chatbot responses are limited by the variables included on their development and that, although many chatbots exist, not all of them are useful. If the chatbot fails, the user will be contacted with a human at the end.

## **USES OF BOTS**

Conversational chatbots are found in fields such as entertainment, commerce, business, health, tourism, marketing, and education (Murad et al., 2017; Pradana, Goh, & Kumar, 2018). They contribute to these fields by increasing users’ satisfaction while providing support in less time. For instance, in business and marketing, chatbots provide customer service tirelessly to answer FAQs (Pradana, Goh, & Kumar, 2018). However, in order to avoid user frustration, the bot should “identify when customers need to speak to live representatives as early in conversations as possible” (Arcand, 2017, p. 4), and redirect them to the appropriate person.

In libraries, users request to a librarian information regarding books availability, location, operation hours, policies, and check out procedures. The chatbot exchange experience is similar than the one with a librarian; it can provide a self-service option for face-to-face and online customers (McNeal & Newyear, 2013; Fichter & Wisniewski, 2017).

In education, “the conversational bots have been developed to support education process in e-learning environment” (as cited in Pradana, Goh, & Kumar, 2018). In higher education, particularly in online courses, students communicate with the instructor by email or phone, asking questions regarding projects, deliverables, deadlines, grades, etc. Instructors often times get a high number of emails that have to be responded usually in a 24-hour timeframe (Martin et al., 2007). Most of the times, questions are repetitive, thus generating repetitive and time-consuming responses from the instructor’s side. In addition, in order to answer some students’ requests, the instructor needs to navigate the web and find the corresponding answer. Martin et al. (2007), note the issue of the

way information is organized, stating that usually the institution “has information available on the official Web Site, in the faculties websites, and finally in every department Web Site” (p. 1). Since information is dispersed in different websites, the process of finding specific information is hard for students, thus requesting from the instructor a response.

Chatbots in education can be used to perform diverse tasks such as answer student FAQs, help with project guidelines, interactive quizzes, streamline processes, and even evaluate student performance. The incorporation of this tool in distance education settings has a promising opportunity to improve communication and overall course experience for online students and faculty teaching these courses.

### **INTEGRATION OF A CHATBOT IN AN ONLINE COURSE**

In this study, faculty from the Educational Technology program at the university were interested in the development of a Frequently Asked Questions (FAQ) section to explain various elements of the syllabus of one of their graduate fully online courses. After reading the syllabus at the beginning of the course, students usually look again during the semester for some specific information, such as the required textbook(s), policies for grading, participation, or project’s submission. As a way to make the process of finding such information easier and more interactive for the student, an FAQ of the syllabus is a helpful option for students. Therefore, faculty were interested in creating a chatbot to answer these questions in a more conversational form, instead of having the students look through all the document to find specific information.

In order to create the chatbot, the faculty looked for an online tool available that was suitable for this purpose. Powerful online tools offering diverse features were tested. However, most of them were either not free or required particular knowledge in order to create and configure the chatbot. After reviewing different characteristics of the online chatbot creators, a tool named Snatchbot was selected as the best option because its features are convenient to this study. The main characteristics of the tool are:

- It is free to use and can be embedded in the university’s LMS (Blackboard). Other free tools are not supported by the LMS and cannot be incorporated as part of the online course. In addition, most of the free bot creation tools have many advertisements included.
- It is easy to manipulate and configure. There is no need to be an expert in natural language, app development, or programming to be able to design and develop a chatbot. Its interface is very intuitive and you can create conversations as simple or complex as needed.
- It creates reports on the use of each bot, and the analytics can be examined for future tool improvements.

#### **Creation and Implementation Process**

A rule-based chatbot was selected to be created for the graduate online course. Since the original purpose was to develop an FAQ for the course syllabus, the main questions that could arise from the syllabus were extracted. As a first step, possible inquiries from students were analyzed and answers were developed and stored in a database. To make the interaction more attractive, answers included diverse type of helpful resources, such as links and images. The FAQ taken from the syllabus were related with the following 8 topics: (1) instructor’s contact, (2) required textbooks, (3) grading policies, (4) late project submission policies, (5) discussion forums participation, (6) project’s makeup or extra credit, (7) project submission procedures, and (8) accessibility services. Therefore, in the conversation with the chatbot, students find answers to common questions such as, *how can I submit my project? can I submit my project late? how am I going to be graded? how can I contact the instructor?*, etc.

In the development process of the chatbot prototype, the answers for each possible question were included as an interaction for communication. Each interaction had sufficient information and resources for the user to get the query responded. Since this is a rule-based bot, the chatbot identifies keywords from user’s input, look into the created interactions, and match the corresponding answer. It then presents the response to the user as text, asks if more information is needed, and waits for the user’s input. This is how the continuous interactive conversation is created; the user requests information, the chatbot answers using friendly terminology and waits for another request from the user, either about the same topic or a different one. In order to facilitate the interaction, buttons for quick replies were used in this chatbot. One button per topic was created and they help the user by giving options to start or continue the conversation.

After the chatbot was developed, it was embedded in the course. Online courses are hosted in Blackboard, which is the Learning Management System (LMS) used at the university. Figure 1 shows the icon that students can click to activate the chatbot. It is located at the bottom right of the page and the icon is colorful so students can notice it. If students use the mobile Blackboard application, the bot is also displayed and students can start a conversation using mobile devices, such as smartphone or tablet.

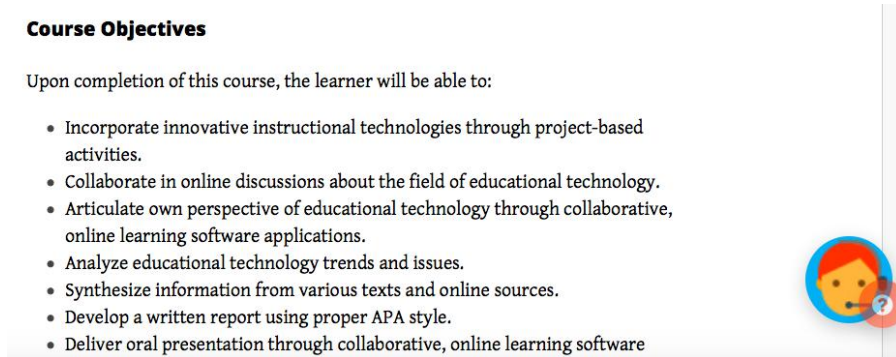


Figure 1. Chatbot's icon displayed in the course

There is also the option to share a URL to interact with the chatbot. With the URL to an external link, the chatbot does open on mobile device browsers like Safari, Firefox, and Chrome. However, the chatbot can also be embedded within an IFRAME in the Blackboard course. When the chatbot is activated with a click, an interface is displayed in the course page, as shown in Figure 2.

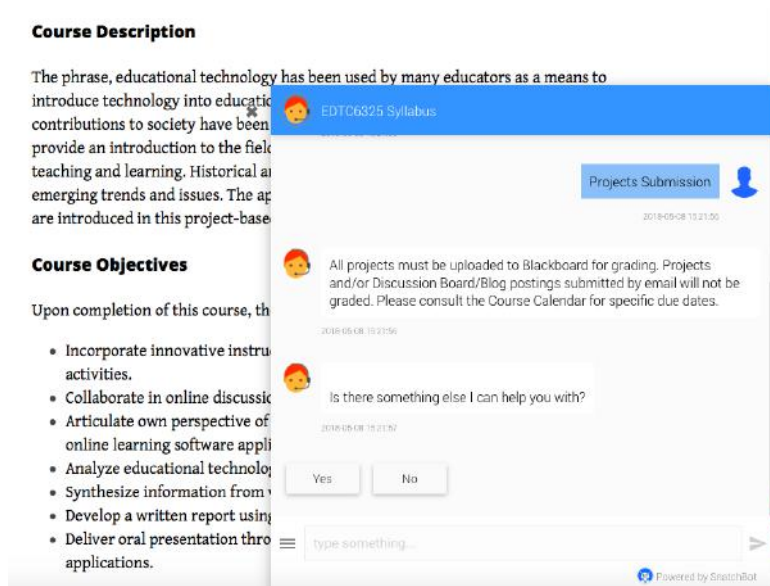
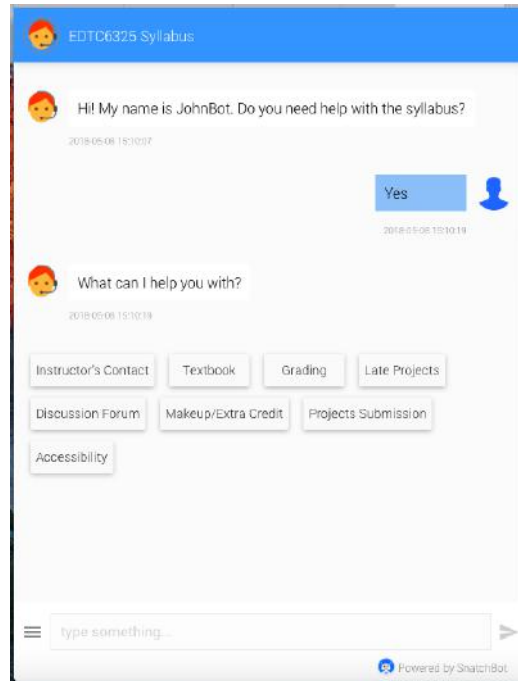


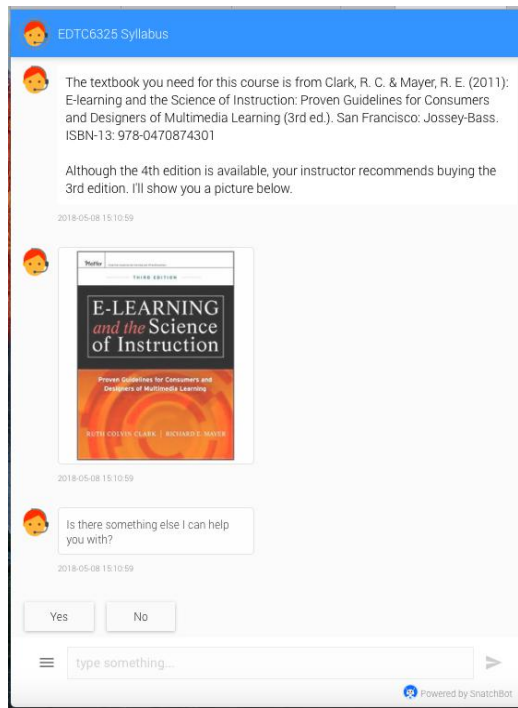
Figure 2. Chatbot's dialogue interface

Students can type their questions or click on the options that the buttons display. As mentioned above, buttons were added including the topics that the chatbot is able to discuss about. For example, in Figure 3, we can see the topics that were included in the prototype created for this study. After receiving the input, the bot responds according to the request. An option to reset the bot and start the conversation again is available at the lower left side of the interface.



**Figure 3.** Buttons and topics included in the chatbot

Not only text-based responses were included, but elements such as links and images were added too. For example, as shown in Figure 4, if a student is looking for the required textbook for the course, the chatbot can display the cover page of the book, as well as the title, author, and edition. If external resources are needed, such as institutional policies or student support services from the university, the bot can display links to those websites. Additionally, links to information in a specific section of the syllabus were included using anchors in the syllabus HTML code.



**Figure 4.** Example of a response using text, images, and links

When the user state that he or she does not want any more information, the chatbot using a friendly language, displays a message with the instructor's contact information and encourages the user to contact the instructor if more help is needed. By using a close (X) button, users can close the chat.

The chatbot prototype embedded in the online course performed satisfactorily. However, since the prototype developed explain only elements related to the course syllabus, there is the need to feed the bot with more questions and answers related to the rest of the course. For example, the chatbot could assists students with inquiries related to the development of individual or collaborative projects by providing extra resources such as, external links, examples, ideas, tools, etc. Resources for each specific section of the project and the required deliverables could be addressed in a chatbot conversation. This way, students can email the instructor only when a question is not answered by the chatbot. As this example, instructor and students can take advantage of the use of bots by incorporating an FAQ related to all aspects of the course.

### **Expanding the Scope of the Chatbot**

In order to expand the scope of the developed prototype, input from final users (students) and instructors was needed. A survey was created and distributed using a blog, where students from the Educational Technology program participate actively during the semester. Participants were graduate students enrolled one or more master or doctoral fully online courses. In the survey, a link to the syllabus chatbot prototype was presented to the students so they could interact with it and get the conception of the type of interaction and information they could obtain. Then they were asked the following questions: *If your online course were to have an FAQ chatbot, what kind of questions about the course would you want or need answered? Aside from answering FAQs, what other uses course chatbots have in online courses?*

Students from the 10 graduate EdTech online courses offered in the Spring 2018 semester at the institution participated in the survey. A total of 57 responses were collected. Answers were analyzed and questions that students could ask regarding their online course were extracted. Also, students' suggestions regarding the possible use of the chatbot were considered. Questions were categorized in the different topics they relate and a database with questions and answers was created. Table 1 presents the main topics and sample questions suggested by students.

**Table 1.** Topics and sample of questions extracted from students

<b>Topics</b>	<b>Questions</b>
Course Navigation	Where exactly can I start this course?
	Where can I find the project deliverables?
	Where do we meet online?
	Where can I submit my assignment?
	How can I interact with my classmates?
Course Syllabus	What textbook is required for this course?
	How can I contact the instructor?
	What day and time are we meeting online?
	Should I know how to use a specific software tool before starting the course?
	What are the institutional policies?
Course Structure	Is the course fully online?
	Is a live session required?
	When is the synchronous session meeting time?
Technical Issues	Who can I contact for technical support?
	What hardware and software will I need to participate in the online course?
	What recommended browser should I use?
Course Calendar	When is the project due?
	When is the Discussion Forum due?
	What are my weekly assignments?
Project Deliverables & Tips	What are the requirements/deliverables for the project?
	Is there an example of the project available?
	What document formatting style should I use?
	How do I write an APA citation?
	What tools are available for me to develop my project?
Assessment	How will I be graded?
	Will extra credit be available?
Discussion Forums & Course Activities	How many responses do I need to post on a discussion?
	What are the required readings?
	Are the assignments group or individual?
Resources	How can I find journals and articles using the university library?
	Where can I go to get online tutoring?
	What tutorials do you have for WordPress, PBWorks?

In addition to the students input, the instructors point of view was also needed in order to feed the bot with questions from both sides of the coin. A total of three instructors teaching fully online courses were asked for the most common questions they receive from students regarding the course. In Table 2, a summary of the most common questions received by instructors are shown.

**Table 2.** Questions provided by instructors

<b>Common Questions Instructors Receive</b>
How will I be assessed for class participation?
Where do I post the assignment?
How do I submit an assignment to TK20?
Can I redo the assignment? Where do I post it if I redo the assignment?
I can't find your feedback. Where should I look?
I'm emailing my assignment to you because I don't know where to put it.
How do I post a project to my e-portfolio?
Why do I need to create a new profile to post to the EdTech blog?
I don't like group projects. Can I work alone?
How do I submit a project if I am taking this course as an elective and I don't have an e-portfolio?
When will you post the grades for the major assignment?

The information collected in this study will serve as a solid base to improve the chatbot prototype in the future. The Educational Technology faculty expect to develop a complete chatbot that includes all the FAQs obtained in this study. This will offer a tool to be implemented in the online course and to be used by students to make their online experience more pleasant.

## CONCLUSION

The future of bots is promising in diverse fields, since they interact with users to perform tasks such as engaging with bank processes, booking a ticket, as well as providing customer support (Marupaka, 2018). Although chatbots in education are on their infancy, Winkler and Söllner (2018) argument that chatbots “have the potential to change the way students learn and search for information” (para. 1), since they can provide one-to-one support.

In this study a pilot chatbot for the syllabus of an online course was developed and implemented. The creation and implementation process were presented, so that faculty interested in the creation of a chatbot can implement it on their courses. However, further development of the pilot chatbot is needed. In order to be fully implemented, the bot still needs to be fed with more statements to cover other topics of the course. The data collected in this study will be used to accomplish this task in order to have a full integration of a bot into a course.

As part of the next steps in this research, a chatbot must be created for each online course in the Educational Technology program, since each course has different characteristics, projects, policies, instructor, and deliverables. The assessment of the impact of bots implemented in the courses is going to be determined in a future study. This will help faculty and course designers determine if the development and implementation of a chatbot for their online courses is a task that can improve students and faculty experiences in online courses. The integration of Artificial Intelligence (AI) and Natural Language Processing (NLP) into a chatbot, to be continuously learning, is imperative in order to recognize keywords and human language, thus improving the conversation experience (Kharchenko, 2017).

As expressed by Winkler and Söllner (2018), chatbots in education are in the very beginning stage. However, some studies show that they can improve learning processes and outcomes. The implementation of a pilot chatbot in the graduate Educational Technology courses is a step to further improve its application and research the potential of chatbots in online higher education courses.



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