Studying How to Apply Chatbots Technology in Higher-Education: First Results and Future Strategies

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Studying how to apply chatbots technology in higher-education: First results and future strategies

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Abstract. This paper tries to find the best condition to use chatbots (conversational agents) in higher-education studies after pilots carried out at the University of Granada (Spain). Our aim, along with the rest of partners in EDUBOTS -an Erasmus+ European Project which counts with two pedagogical chatbots-, is to improve students' engagement in class, as well as reducing the existing gap between them and their teachers. In this paper we present the results of a previous survey carried out among the students with the intention of laying out a plan of possible effective applications of this technology in the classroom in the near future, if possible during the next project pilot. The survey helps us confirm the reasons for the learning outcomes in the carried out pilots, as well as identify the targets for future application of chatbot technology.

Keywords: higher education, chatbots, student-teacher communication, messaging platform.

1 Introduction

Conversational agents or *Chatbots* are software programs that interact via written or spoken word with persons or groups of persons [12,4,7]. They can be found currently in many environments such as webpages, applications and, of course, in our 'smart' devices (smartphones, smart TVs, smartwatches, and even smart rings). Thus, chatbots have become an incredibly useful tool in many domains and applications, with the virtual assistants created by Google, Apple (Siri) or Microsoft (Cortana), be it in text or voice, being the most famous.

They are, essentially, autonomous agents using many Artificial Intelligence techniques [1], such as Natural Language Processing, Automatic Speech Recognition, Data Mining, Machine Learning, or Sentiment Analysis, to cite a few. Thus, most of them are close to passing a classic Turing test [8] (at least for a non-expert human), since they are able to answer almost any speaker's question fluently, and even ask other questions to the human.

They might use natural language processing to understand a conversation and insert themselves in a one-to-one or grupal chat group. This is, however, not strictly necessary for many uses, even more so in an educational environment.

Chatbots have been used in a lot of areas, however there are still very few applications of them in education environments, and almost none in higher-education. One of the main reasons is the existing lack of knowledge regarding how to implement and train the chatbots for specific scenarios in this domain, as well as which issues or tasks should they address in the educational process.

It can be identified some preliminary problems of the adoption of chatbots in this scope, such as their difficulty to be integrated in common Learning Management Systems (e.g. Moodle); or the use of proprietary applications that cannot be integrated with popular messaging systems like WhatsApp, Telegram or Discord.

Therefore, even if we surround these issues, the use case definition for educational chatbots is not an easy task.

According to some researchers in this topic [25] is the teacher who should supervise and control the educational process and maybe these agents should be focused on helping them in these tasks, rather than substitute them in any of their teaching responsibilities. However, nowadays there are extensive studies on how humans interact with chatbots [22]; for instance, how the mood transmitted by the bot affects interaction; even so, according to [28], we are still in the very beginning of the application of these techniques to increase learning outcomes.

In this line, EDUBOTS project ("Best practices of pedagogical chatbots in higher education") has as aim to successfully apply chatbots in higher-education as a mean to fill the existing gap between educators and students due to the usual existing high ratio, which makes it very difficult to achieve a desirable formative assessment as well as providing personalised feedback.

The plan was to deploy and test different instances of two specialised chatbots in four universities around Europe in the UK, Latvia, Croatia and Spain; also with the participation of partners from Sweden, Cyprus and Norway. Each of these chatbots will interact -in text mode- with students of different degrees and subjects per university, ideally in their mother tongue.

The present study will be placed in a preliminary step, thus, prior to actually creating or implementing bots in class, we need to find out the actual needs for students, and since they are chatbots, we need to know where the students actually chat and in which context, i.e. which messaging systems or chat rooms/channels they use normally.

Thus, the main objective of the present work, is to directly ask the main actors in this scenario: the students, and then extract some conclusions based on their answers.

To this end, we report a survey among higher (bachelor and master degree) education students at the University of Granada, mostly in tech-oriented degrees, which focused on the messaging applications they used, how they used to interact through them with their peers, and what they would want the chatbots to do. That will be used later on to design pilot experiments that will introduce chatbots in the messaging applications they actually use (if it's at all possible).

Then, the survey responses have been analysed and, from them, some conclusions have been extracted on the best strategies or steps to follow in order to use chatbots successfully in such an educational environment, i.e. increasing the feedback to the

teacher, enhancing the students' engagement, having a better student follow-up, and reducing the dropout rates (mainly in the first academic years).

The rest of the work is organized as follows: next we present a brief state of the art in the use of messaging and other technologies and chatbots in the classroom, including any intelligence that's added to them. After this, we briefly introduce the project in which this study is enclosed. Then we will describe what we did for this specific survey and why, and finally we will report the results, proposing action lines to apply chatbots in higher-education.

2 State of the art

The introduction of new technologies in the classroom has demonstrated to be very effective in order to increase the students' motivation and engagement, as well as to enhance their performance and academic results [5], mostly on the new so-called 'digital generation'.

These are normally applied as a way to increase the interactivity during classes, for instance using electronic devices for interaction and feedback [16,26,10], approaches to let the students pose questions to the teacher for its resolution during the class [6], or even using commercial mobile applications for educational purposes during the class [13].

Many proposals have followed an approach based on the so-called *Edutainment* (or educational entertainment) [21], that is, aiming to improve aspects of education through a system that also entertains. This kind of *Serious games* (games created for educational purposes rather than to have fun) have been very prolific in several educational settings, including technical degrees [18].

Chatbots have existed for many years [24]. In the field of education chatbots have been used for both providing information to the user or facilitating student learning [15,3,2]. Chatbots can help students and teachers in many ways, e.g. automatically grading questions posed to students, or compiling the highlighted points mentioned by the majority of the students, and further send it to the teachers, giving them the opportunity to identify gaps in their teaching efforts and improve their classes and explanations [27]. For example, an approach to introduce these devices in high school teaching is presented in [9] where Google Echo and Amazon Alexa are questioned about some common concepts in the STEM area with poor performance on the answers but increasing the motivation and interest in the students.

However, almost all the approaches are focused on the increase of the students' participation and engagement during the classes (catching their attention), while almost none of them is worried about other existing flaws. For instance, a weak point in the teaching of subjects in higher-education (in almost any Degree) [14], is the student-teacher feedback, normally focused on the feelings and engagement that the students have during classes, but which could also be translated to a general feedback about the subject. Since, once the students leave the classroom it is quite difficult to get in contact with them and to receive this type of comments/criticisms.

Thus, in order to cover this weakness, EDUBOTS project partners have created two pedagogical chatbots specialised in ease some aspects of the subject management to the teacher, as well as serve to reduce the existing communicative gap between the

students and their professor. One of these chatbots can also be utilized as an informal breaking ice tool to meet colleagues in the first academic courses,or as a formal academic communication tool between them. These agents are described in the next section.

3 EDUBOTS Project

"Best practices of pedagogical chatbots in higher education" (EDUBOTS) is the name of an European Project funded by program Erasmus + KA2: Cooperation for innovation and the exchange of good practices - Knowledge Alliances.

In it, the consortium, composed by some European companies and Universities, aim to apply two different chatbots in higher-education in order to improve the students' performance, engagement and to effectively reduce the dropout rates at this stage.

Two different chatbots are to be used in the project, each of them focused on a different objective, namely:

- ***Differ***: created by EdTech Foundry AS (Norway) - www.differ.chat
  Aiming to stimulate student collaboration, creating informal and 'safe' online communities where students can chat with other classmates in an anonymous way.
- ***Hubbert***: created by Anna & Hubert AB (Sweden) - https://hubert.ai/
  Which aims to automate the feedback to educators. This chatbot has been mainly used in other domains, such as the recruitment of human resources in companies, doing an initial job interview for filtering candidates, for instance.

Both bots were accessed by the students using a common interface, being introduced by mentors, i.e. students selected to collaborate in the project for ice-breaking. However, unfortunately, the chatbots only worked in English, German and Swedish languages at the first pilots, which was a handicap in some universities such as Granada, as we comment in [19].

4 Students Surveys

4.1 Initial survey

After the initial pilot, reported in [19], which revealed that our initial assessment of the needs and attitudes of students with respect to using chatbots in their education was not in line with what we actually obtained in the pilot, we decided to start from scratch looking at several different things: first, what kind of chat "rooms" or "channels" would students prefer, and what kind of functionalities would chatbots add to those chat rooms. Additionally to the conclusions shown in [19], it was concluded that students didn't want to use a new chat system additionally to the ones they were using already, and on top of that, it was very likely that a chat that (possibly) included all students in the course was not the best option either. Besides, there was little functionality in that pilot beyond the possibility of meeting new people.

At the same time, since the new pilot included new functionalities, such as the possibility of establishing FAQs, although it came at the cost of including professors in the chat rooms; it still needed a specific chat application. This is why we designed a new survey with the initial intention of getting responses into the design of the new EDUBOTS pilot.

In order to probe the attitudes of students, we published an initial test survey consisting of only two questions: one related to the scope of the chat rooms they would like to participate in, and another related to the functionality of chatbots. This survey was done via Telegram, in Spanish, using the already existing class-wide telegram group for two classes, one in the last year of Computer Science, and another in the Master. More than 100 students participated in it.

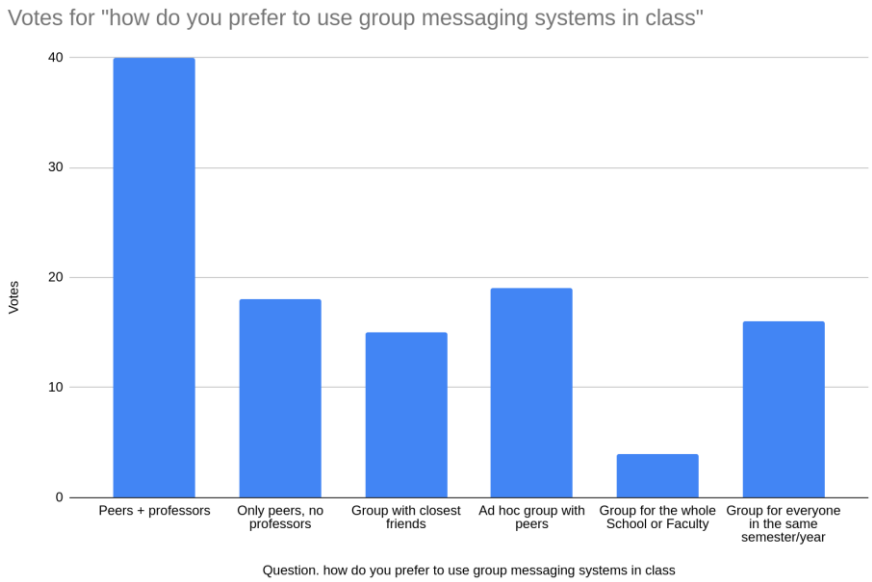

Fig. 1. Most selected answers to the first question of the initial survey.

The answers to the question about the scope of the chat channel are shown in Figure 1. In this case, there were 57 answers and students could check as many answers as they wanted. This initial survey confirmed our conclusions of the pilot study, but at the same time helped us discard questions if we wanted to create a wider survey.

With respect to the type of functionality that students would want there, the chosen answers are shown in Figure 2. This specific Telegram group already included a bot that answered questions about the next deadline, and this was indeed one of the most popular answers. As a matter of fact, meeting new people was not considered valuable (as it is in EDUBOTS project), but we should take into account that these students had already been in the same class for many years.

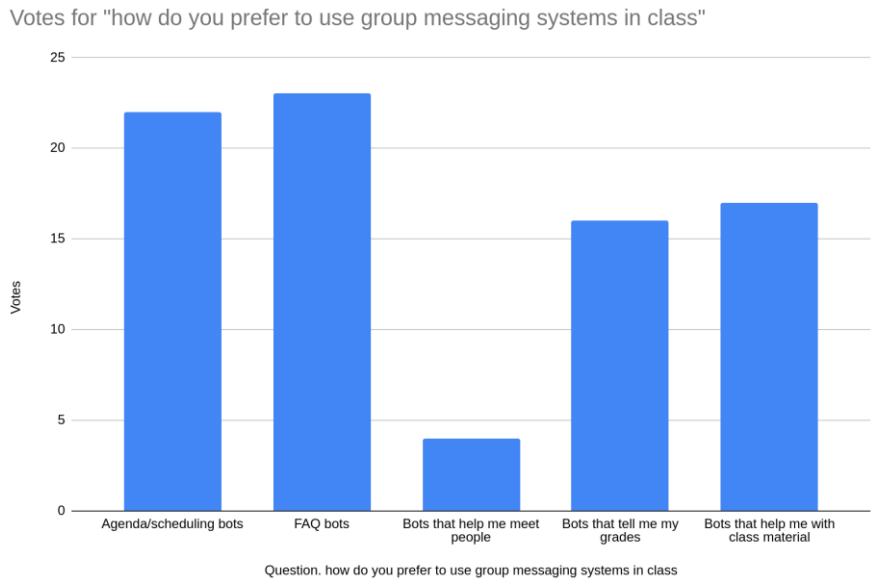

Fig. 2. Most selected answers to the second question of the initial survey.

These answers allowed us to design a more directed survey, which is reported below.

4.2 **Extended survey**

After these first results, a bigger group of students were asked to complete a new short survey with only 3 questions about the use of chatbots in their studies and instant messaging services and social networking in Education. Although it may pose a challenge, the survey was purposely limited to only 3 questions to encourage students to participate. The questions analyzed crucial variables such as the type of members in their class groups (Q1), chatbot objectives (Q2), and their current use of messaging services (Q3). Specifically, the questions were:

- Q1. *Who would you like to be part of your class messaging service group?*
- Q2. *Which kind of chatbot would you consider useful to improve the learning process in class?*
- Q3. *Currently, which messaging service do you use to get in touch/contact with other classmates or teachers?*

The first question aims at analyzing the social interaction within class groups, from classmates and the teacher to broader social contexts such as the whole year class, or the whole University School. Next, Q2 asks for particular interests in chatbots considering: *calendar bots* that offer reminders for assignment deadlines or exams, *FAQ bots*, *bots to meet* classmates, *bots to provide grades*, *study material*, or *official academic and bureaucratic information*. Finally, the last question provides data about

the familiarity with different instant messaging services, and the experience with services that already include popular chatbots (e.g. Telegram).

Additionally to the chatbot questions, some self-identification and 'profile' queries regarding age, gender, current studies and (optionally) previous studies were included. Self-identification responses are detailed in Figure 3.

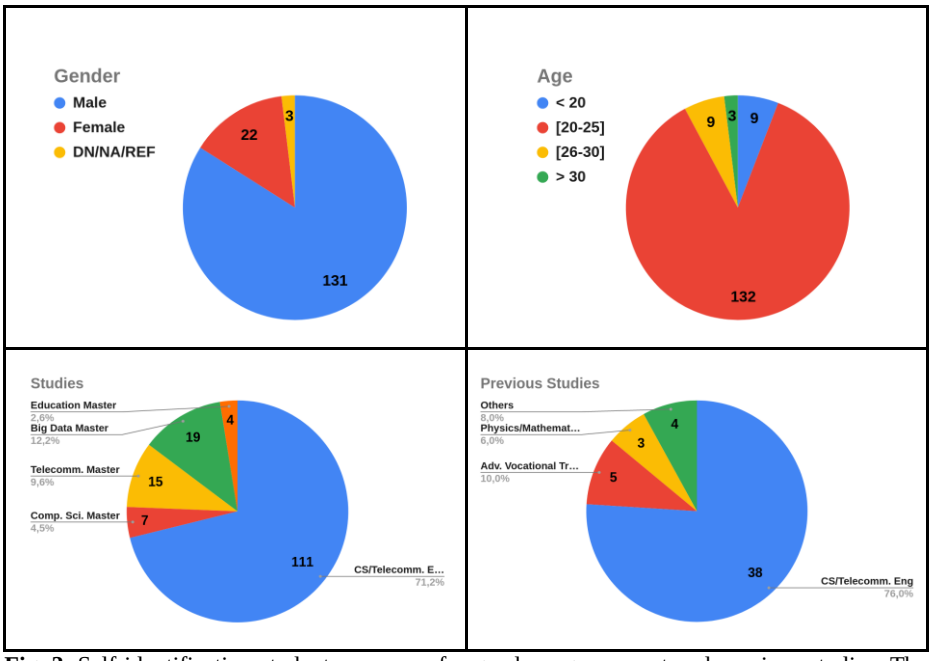

Fig. 3. Self-identification student responses for gender, age, current and previous studies. The questionnaire gathers information of a predominantly male population, between 20-25 years old undergraduate students mainly from Computer and Telecommunication Engineering. Regarding background diversity, some responses come from the Education Master students that include graduates from Physics and Mathematics, Statistics, Philosophy, or History.

We collected responses from a total of 156 students (undergraduate and master's) of the University of Granada, all from ICT backgrounds, namely Computer Science, Telecommunications, and Education for Technology and Informatics. Our aim was to include students that had strong links with technologies and were already familiar with chatbots.

4.3 **Extended Survey Results**

The most important facts of the 156 completed questionnaires are summarized next: Regarding the profile (Figure 3), ICT students are predominantly male and thus overrepresented in our work with approximately 85% of males' responses and 15% females. Most students (86%) are in the range 20-25 years old which represents the average age for undergraduate and master's students; 6% are younger than 20 (first years of their studies) and 8% older than 25. With respect to the background diversity, 72% of them study Computer Science and Telecommunications, 26% are ICT

master's students, and interestingly 2% are students from the Master in Education for Technology and Informatics.

Since some groups are underrepresented, we will not discriminate responses per group; the intention of providing this data is simply to show the overall composition of responders to the survey, which is roughly the same as the composition of the classes where it has been distributed.

Figures 4, 5 and 6 summarize the results for questions Q1-Q3, comprising the responses from the 156 students.

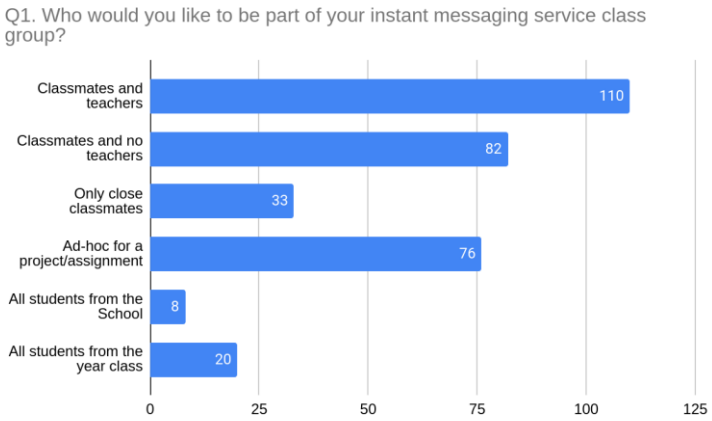

Fig. 4. Distribution of responses for multiple choice, multiple answers for question Q2: members of class groups targeting social interaction and group size.

Regarding the social extent (Figure 4), students primarily prefer groups with their own classmates and teachers (71%) closely followed by only-student groups (53%). Also, almost 50% consider potentially interesting ad-hoc groups created for a specific project or assignment that will eventually be abandoned after the submission deadline. Bearing in mind that the question allows students to select as many options as wanted, let us highlight that less than 15% of students find potentially useful year class groups and only 5% groups for the whole University School. Consequently, students find more useful smaller instant messaging groups whose objective is well-defined and even tuned for a very specific task, and probably consider other alternatives for broader social interactions. An unusual result is that only 20% consider a group for close classmates. This may be due to certain overlapping with other options (a group for classmates or an ad-hoc group for a specific project/assignment), or to the use of other forms of communication with close classmates.

The analysis of question Q2 (see Figure 5) produces engaging results for the use of calendar chatbots (more than 90% students find them useful), or bots that provide grades (65%) and study material (60%). However, similarly to the results for Q1, bots with more general objectives that provide responses for frequently asked questions (23%) or official academic information (less than 1%) are less demanded. Finally, let us emphasize that about 23% of students find useful a chatbot for helping them meet other classmates. The objective of this bot is not academic and thus, it is difficult to analyze the result without a more thorough analysis and additional questions.

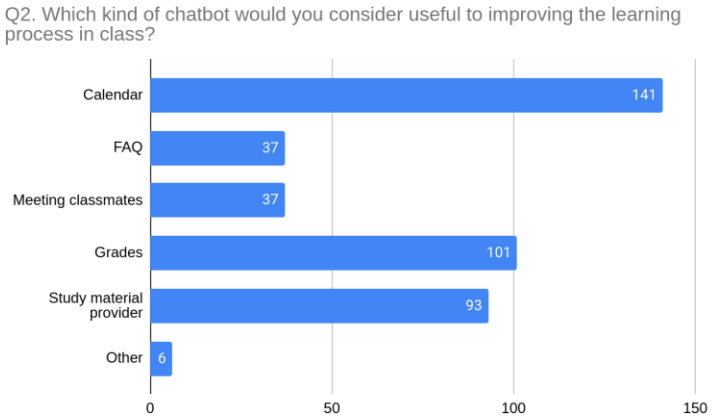

Fig. 5. Distribution of responses for multiple choice, multiple answers for question Q2: potential functionalities of chatbots for Education.

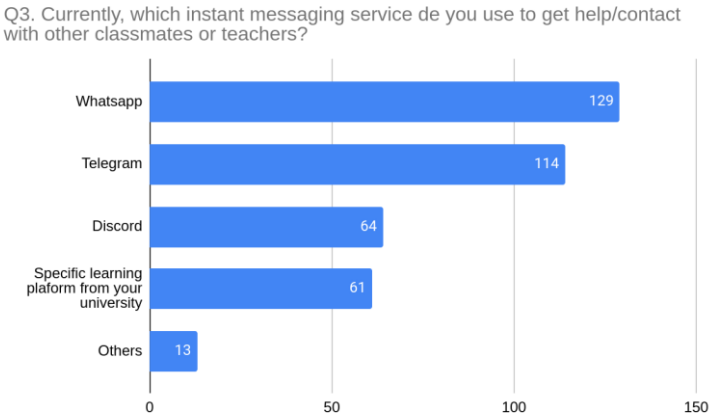

Fig. 6. Distribution of responses for multiple choice, multiple answers for question Q3: use of messaging services that may unveil previous experience and point at target service platforms for the development of effective chatbots.

Question Q3 (shown in Figure 6) analyzes the current use of instant messaging services in Education and the familiarity with services that already offer popular chatbots as Telegram. Most popular instant messaging services are overrepresented e.g. Whatsapp and Telegram. Moreover, specific learning platforms from their University are used by almost 40% of students. This result was expected since some courses enforce the use of these platforms especially for the communications with teachers, to provide online class materials, or inform about grades. Finally, it is interesting the position of Discord servers (40%) that are popular in the videogame culture due to their low latency, anonymity, and robust hardware infrastructure [17], but are increasingly gaining notoriety in other fields. Concerning this matter, lately some works in the literature showed very positive results increasing motivation and

initiative when using Discord with small groups, specifically for team-based learning [11]. Other services include e-mail, Twitter groups or Slack and all of them aggregated represent less than 4%.

Once the survey results have been analysed, in the following section we present some ideas to effectively apply chatbots in these studies, following the reached conclusions, i.e., the students' opinion.

5 Methodological approaches to introduce chatbots in higher education

Considering the answers given by the students in the previous section, it is possible to devise some strategies to be tested in the classroom during future courses (or future pilots of the project). This section presents some ideas that could be implemented in parallel or isolatedly.

The requirements set to define the following approaches have been thought considering the use of messaging groups per course - maybe in WhatsApp, Telegram or inside Differ chats and communities - where both the students and the professors are involved.

5.1 Scenario 1: Passive Group Chat

All students share a group chat where they can propose questions and by themselves, answer other students' questions.

The role of the professor should be more passive just controlling that no inadequate interactions are done (insults i.ex.). Nonetheless, the guidelines and instructions on how to use the group should be prepared by the professor and given to the students at the beginning of the course.

Once the course is finished, several metrics can be computed according to the type of questions and answers made by each student and this can be included in the final mark. Co-evaluation can be introduced by giving the chance to the students to give the highest mark to the students that contributed the most valuable answers or the most useful.

The inclusion of a chatbot could be useful to automatise the collection of statistics. By doing so, these metrics could be updated in real time so a student can be aware of its progress towards achieving this objective on the course.

5.2 Scenario 2: Active Group Chat

In this approach, as the one commented above, the students share a group where the professor is included. The main difference is the role the professor adopts, in this case, should be active and dynamiser.

The professor should propose regularly (at least one interaction per week) some ideas to be discussed related to the course topics and anything related to the course that could appear in the media. By doing this there is the chance to enforce the meaningful learning in the interpretation given by Moreira in [20] discussing the ideas proposed by David Ausubel during his career. A new aspect that should be included

in the interaction is the emotional part. Although this is mandatory during high school, in college and beyond should not be forgotten, especially in adverse situations like the recent confinement due to COVID-19 pandemic [23].

Chatbots in this context could be used to ameliorate the burden of greeting to every user, set reminders to interact and participate in the current discussion. For the sake of clarity the chatbot could rank the interactions to avoid too many similar or redundant answers when dealing with a topic.

Although polling functionality is something that tends to be embedded in the messenger platform, chatbots could collect the results of the surveys thrown by the professor. This could simplify the off-line analysis in order to provide marks.

5.3 **Scenario 3: Correcting exercises**

Chatbots can be very useful to check if a list of exercises proposed to the students have correct answers. Instead of providing the students with the classical answer sheet. It could be possible to include this answer sheet within the chatbot so the students are obligated to ask it about if the answer they obtained is correct or not. A few hints can be included after a few trials have been carried out. For this approach, it seems more interesting the individual perspective as the students will not feel intimidated by showing the number of times they are mistaken.

Metrics on trials can be computed to evaluate the complexity of the assignments proposed.

6 Conclusions and Future Work

In this paper we have reported the results of a survey among higher education students trying to design some scenarios for the use of chatbots, after the experience of some initial pilot programs carried out in the University of Granada, in Southern Spain.

The first result of this survey is that all students use Whatsapp, and most of them, at least in a technological degree, use Telegram. This makes these platforms the ideal one for the deployment of chatbots in higher education. As a matter of fact, it is not a trivial matter to design a WhatsApp bot and, besides, this platform is not a good one to share with students since the phone number of the teachers needs to be available. Telegram, on the other hand, has a free client and free development kits, and bots can be created and deployed using free software and platforms with a free tier. This is why the use of Telegram would be very recommended to deploy any kind of bot. Thus, it is very important to incorporate similar functionalities to the chatbots to use, such as the Differ chat communities.

However, from the results we can see that at any rate, in order to be successful, a chatbot should be deployed in a platform that students already use, and that meets the privacy (and other) requirements that anyone involved has. So, it will be a difficult challenge to motivate students to use a novel tool.

The second question concerned who should be included in the chat group, and in this case there seems to be a certain consensus that there should be one group that included the teachers, although the common practice seems to be to have two groups,

one with and another without the teachers. This would be, then, the target for the chatbots since professors could easily create or curate frequently asked questions (FAQs) as well as other content that would be required.

These are the kind of bots that would be more popular among the students. As a matter of fact, FAQ and agenda bots seem to be what the students are looking for, as well as informative bots that inform the student about the grades, help them with class material (for instance, searching something among the class material). In the case of the FAQ there seems to be a certain discrepancy in the second group of surveys, which put it at the same level as meeting new people. At any rate, it seems quite clear that meeting new people is not a very popular option for using chatbots.

These results explain the outcome of some of the initial pilots, but at the same time propose a survey-based methodology for introducing new technologies in higher education: they should piggyback on products that students already used, they should take into account what the students want to obtain from them to form a good use case, and they should offer an open and free-software based programming interface so that the creation of specific bots can be either done from scratch or tailored to different institutions or locales. In the proposed scenarios we also present different possibilities where, according to the survey results, the learning outcomes of using messaging applications endowed with chatbots would be positive.

These results open many different lines of work. We should probably extend the surveys to many other different locations and degrees, so that we can draw conclusions on the best scenarios for higher education at large. We will also try to follow up on the survey results by implementing bots in Telegram, and see if their use and learning outcomes actually match what the students responded to in the survey. This will be done as free software, and released in the near future.

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