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# Application of the Chatbot in University Education: A Systematic Review on the Acceptance and Impact on Learning

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**Abstract.** During the pandemic, many students faced significant challenges due to the abrupt transition to online learning and the lack of direct interaction with each other and with teachers. Therefore, it is

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relevant to study the contribution of conversational agents or chatbots in university education. This article aims to identify and describe the acceptance of the use of the chatbot and its impact on learning in university education, in the context of COVID-19. A systematic review was employed using a mixed-method approach with of the aim to explore the reasons behind the use of chatbots in university education to solve problems related to the lack of student interaction, motivation, as well as the lack of teaching tools and strategies. It was also identified that the criteria used to evaluate the acceptance of the use of a chatbot are design, interface and responsiveness. Finally, chatbots generated a positive impact on learning, evidenced not only in the improvement of academic performance but also in the interaction between students and teachers. The study concluded that the acceptance of the use of a chatbot and the positive impact generated on learning in university education during the context of COVID-19, will, in the current post-pandemic scenario, lead to the implementation of artificial intelligence tools such as the chatbot to traditional educational environments, transforming the way in which teaching and learning are taught, providing new opportunities for educational growth, under a more flexible and personalised learning.

**Keywords:** chatbot; university education; acceptance; impact; learning

## 1. Introduction

Nowadays, the usefulness and significant contribution that artificial intelligence generates in different fields of education (Vera, 2023) is evident; and it is found to be a support tool for teachers and students (Toasa, 2023; Valverde, 2021). Artificial intelligence is based on algorithms capable of recognising patterns or common characteristics in large volumes of data, through highly advanced digital and technological strategies, seeking to imitate the way in which the human brain works (Giró-Gracia & Sancho-Gil, 2022; Maita-Cruz et al., 2022). It seeks to generate models that allow predicting performance indicators on various factors involved in improving education (Gómez, 2022). In the specific context of higher education, artificial intelligence offers a series of opportunities and benefits, personalising learning, improving the effectiveness of the training process and increasing student motivation (Castrillón et al., 2020; Méndez, 2021). Therefore, higher education institutions are reflecting on educational practices by designing flexible teaching spaces that consider the use of artificial intelligence (Ayuso-del Puerto & Gutiérrez-Esteban, 2022; Ocaña-Fernández et al., 2019).

However, one aspect to consider is the relevance that artificial intelligence has acquired in recent years, not only due to the trend of the increasing use of algorithms, social networks or learning management systems, but also due to the precipitous situation generated by COVID-19 (González & Bonilla, 2022). This scenario brought uncertainty to the students due to the changes in dates for the development of academic processes, which urged teachers and university authorities to become aware of the search for communication and interaction mechanisms through artificial intelligence (Mata & Dávila, 2020). Under this panorama, the development of open source software gained strength, whereby

collective intelligence was identified as the gear to obtain a high-performance and multipurpose program (Díaz, 2020). Thus, chatbots have been manifested as a tool for solving various problems, mainly due to their easy use and access by users, and being useful in times of COVID-19 (Olivera et al., 2021). In other words, when a user enters any question in a chatbot, it relies on artificial intelligence to give the answer immediately, presenting the text in a conversational way (Bonales et al., 2020).

A chatbot is a computer program that interacts with people through a text or voice channel and which can offer automated instant answers and solutions to repetitive tasks and common questions (Arias-Navarrete et al., 2020; Galindo-Monfil et al., 2022; Llugsa & Vaca, 2022). They are also known by other names such as bot, chatterbox, intelligent computational agent, virtual assistant or conversational assistant, among others (Mazón, 2021). Chatbots rely on natural language processing and machine learning, automating responses to queries that are commonly made by users of any type of service (Flores et al., 2020; León-Granizo & León-Granizo, 2020; Martín-Ramallal et al., 2022). One aspect to consider is that chatbot training should be done using data organised by humans, because they are susceptible to errors when only supported by information from the Internet (Collazos & Estupiñan, 2021). On the other hand, they have the ability to re-train and update themselves, thereby improving their responses each time, making them more accurate and reliable (Miguel, 2021). In addition, they can be integrated not only on web and mobile platforms, but also within social networks such as Twitter or Facebook (Rodríguez et al., 2018).

Returning to the context of the educational field, providing general information about the university is one of the first actions to take into account, and which should be dealt with by the different departments in charge of providing educational guidance to students (Guerrero-Bocanegra, 2022). Under the aforementioned, a chatbot can be used as an intelligent tutor, interacting with students, automating questionnaires, streamlining routine processes and allowing teachers to monitor the evolution of students (Orozco-González et al., 2020). Thus, chatbots provide elements of interactivity between all those involved in the teaching-learning process (Torres et al., 2022). Therefore, when including this technology in university education, it is necessary to take into account some special aspects of its implementation, such as expressiveness, motivation and adaptability to capture the user's attention and fulfil the purpose for which it was created (González et al., 2020). In addition, in order to know the degree of acceptance of the chatbot in the linking processes at the university level, satisfaction surveys must be applied to the students (Pérez & Céspedes, 2021; Ponce et al., 2022). In most investigations, the experience of the users and their perception towards these systems have been evaluated (Albizu, 2019). These evaluations or tests make it possible to identify which aspects should be improved in the chatbot at the usability level (Castillo et al., 2021).

In this sense, the objective of this study is to identify and describe the acceptance of the use of the chatbot and its impact on learning in university education, in the context of COVID-19. For which it is intended to develop a systematic

review of literature based on the PRISMA statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). The manuscripts to be analysed will be extracted from the Scopus, ERIC and IEEE Xplore databases. The methodology used focuses on an exploratory-descriptive level study, under a mixed-method approach. In addition, the study aims to answer the following research questions:

- RQ1: What is the motivation that led to the use of the chatbot in university education, in the context of COVID-19?
- RQ2: What are the criteria used to assess the acceptance of the use of the chatbot in university education, in the context of COVID-19?
- RQ3: What is the impact on learning when using chatbots in university education, in the context of COVID-19?

## 2. Methodology

### 2.1 Focus and level of investigation

A mixed-method approach was used in this study due to the fact that a qualitative analysis of the chatbot and its application in university education was initially carried out. In other words, a content analysis of each manuscript included in the systematic review was carried out, seeking to code and categorise the reasons or motives that led to the use of the chatbot, as well as the criteria used to evaluate its acceptance. We then proceeded to carry out a quantitative analysis seeking to identify the motivation or reason that most justified the use of the chatbot in university education, as well as to identify which criterion was used to a greater extent to determine the acceptance of such use; thus exploring the impact of the chatbot generated on learning in the context of COVID-19. In addition, the level of the research is exploratory-descriptive, because the study to be developed took as its starting point the examination of scientific evidence regarding the findings on the chatbot and its application in university education. Then, similar or different relevant characteristics or aspects related to the motivations or reasons that led to the use of the chatbot in university education were extracted, as well as the criteria used to evaluate the acceptance of its use. Exploratory-descriptive level studies aim to specify the characteristics, variables and dimensions of a concrete reality from a new perspective (Guevara-Herrero et al., 2023).

### 2.2 Data extraction

For the extraction of data or manuscripts that show findings or results on the application of gamification in university education, the phases established in the PRISMA declaration were taken as a reference, these being: initial phase of identification of manuscripts, phase of projection manuscripts , phase of eligible manuscripts and phase of manuscripts included for the analysis and synthesis of findings, which will lead to the development of the systematic review on the acceptance of the use of the chatbot and the impact on learning in the context of COVID-19. In the first phase, the search equations for the Scopus, ERIC and IEEE Xplore databases were established. These equations were structured according to the keywords defined for this study, these being: chatbot, conversational agent, university students, academic performance, student dropout, and student interaction, all expressed in English. Table 1 shows the

equations, which were determined according to the search engine syntax of each database. It should be noted that, in this first phase, a total of 654 manuscripts were extracted from the three databases. However, by excluding repeated manuscripts, 550 documents were identified.

**Table 1: Search equation**

| Database | Equation |
|---|---|
| Scopus | (TITLE-ABS-KEY (chatbot)) OR (TITLE-ABS-KEY (conversational AND agent)) AND (TITLE-ABS-KEY (university AND students)) OR (TITLE-ABS-KEY (academic AND impact)) OR (TITLE-ABS-KEY (academic AND performance)) |
| ERIC | (((chatbot) OR (conversational agent)) AND ((university AND students) OR (academic AND impact) OR (academic AND performance) OR (student AND desertion) OR (student AND interaction))) |
| IEEE Xplore | ((chatbot) OR (conversational agent)) AND ((university AND students) OR (academic AND impact) OR (academic AND performance) OR (student AND desertion) OR (student AND interaction)) |

In the second phase, we proceeded to exclude those manuscripts whose title and abstract were not strictly related to the topic under study. Thus, at this stage, 358 manuscripts were excluded from the total number of articles identified in the first phase, finally determining a projection of manuscripts made up of 192 documents.

In the third phase, a set of criteria called inclusion and exclusion criteria was applied, which allowed to achieve greater precision regarding the manuscripts to be chosen for the phase of analysis and synthesis of results regarding the application of the chatbot in university education in the context of COVID-19. Table 2 shows the inclusion and exclusion criteria, defined for this systematic review, which specifies the study population, the type of manuscript, the availability or access to the content of the manuscript, the type of review to which the manuscript was submitted and the period of publication of the manuscript. It should be noted that, by applying these inclusion and exclusion criteria, it was possible to determine the eligible manuscripts for the systematic review, which turned out to be 22 documents.

**Table 2: Inclusion and exclusion criteria**

| Criterion type | Criteria |
|---|---|
| Inclusion | • Manuscripts that show the results of the impact of the chatbot application in university education.<br>• Manuscripts in which the total content of the investigation is displayed.<br>• Manuscripts that were submitted to peer review.<br>• Manuscripts defined as scientific articles and conference papers.<br>• Manuscripts published during the years 2020 to 2022. |

| | |
|---|---|
| Exclusion | • Manuscripts that show the impact of the chatbot application in education at the primary or secondary level.<br>• Manuscripts with restricted access or that only show the title and abstract of the research.<br>• Manuscripts that were not subjected to peer review.<br>• Manuscripts defined as books, book chapters, or theses.<br>• Manuscripts published before the year 2020 and after the year 2022. |

In the fourth and final phase, an exhaustive review of the complete content of each article was carried out, based on the research questions. In this way, in this phase, an evaluation of the quality of the 22 manuscripts chosen in the previous phase was carried out, with respect to the purpose of the study. It should be noted that this evaluation is part of the mechanisms used to minimise bias regarding the manuscripts to be used in the phase of analysis and synthesis of results. This evaluation excludes those manuscripts that, even meeting the inclusion and exclusion criteria, were not related or associated with the research questions to be addressed in this systematic review. The instrument used is an adaptation of the instrument used by Ávila and Gómez (2017), in which four criteria are used to assess the quality (CAQ) of the manuscripts included in the systematic review. The adaptation allowed the evaluation instrument to be used in the studies addressed in this systematic review. These criteria were as follows: impact of the application of the chatbot to university education (CAQ1), methodological coherence (CAQ2), clear argumentation (CAQ3) and whether the manuscript contributes to the field of study (CAQ4). Table 3 shows the results of the quality assessment expressed as a percentage, according to the purpose of the study. The scores for each criterion can take the values of 1, 3, and 5, representing a low, fair, and high rating, respectively. The minimum percentage for an article to be considered quality is 50%. By applying this evaluation, it was possible to establish that the manuscripts included in the systematic review process consisted of 16 documents.

**Table 3: Assessment of the quality of the manuscripts according to the purpose of the study**

| Reference | CAQ1 | CAQ2 | CAQ3 | CAQ4 | Total |
|---|---|---|---|---|---|
| (Yin & Satar, 2020) | 5 | 3 | 3 | 5 | 80% |
| (Vanichvasin, 2021) | 3 | 3 | 5 | 5 | 80% |
| (Neo, 2022) | 5 | 5 | 5 | 3 | 90% |
| (Çakmak, 2022) | 3 | 5 | 3 | 5 | 80% |
| (Chang et al., 2022) | 5 | 5 | 3 | 5 | 90% |
| (Abbas et al., 2022) | 5 | 3 | 5 | 5 | 90% |
| (Essel et al., 2022) | 5 | 5 | 5 | 3 | 90% |
| (Yin et al., 2021) | 3 | 3 | 5 | 5 | 80% |
| (Mellado-Silva et al., 2020) | 5 | 3 | 3 | 5 | 80% |
| (Uceda et al., 2021) | 5 | 5 | 5 | 3 | 90% |
| (Al Kahf et al., 2023) | 3 | 3 | 5 | 5 | 80% |
| (Malik et al., 2021) | 5 | 5 | 5 | 3 | 90% |
| (Vázquez-Cano et al., 2021) | 3 | 3 | 5 | 5 | 80% |
| (Ren et al., 2022) | 3 | 5 | 5 | 3 | 80% |
| (Almahri et al., 2020) | 5 | 5 | 5 | 3 | 90% |

| | | | | | |
|---|---|---|---|---|---|
| (Lee et al., 2020) | 5 | 3 | 5 | 3 | 80% |
| (Bailey & Almusharraf, 2021) | 1 | 3 | 1 | 1 | 25% |
| (Roy et al., 2022) | 3 | 1 | 1 | 3 | 40% |
| (Valles-Coral et al., 2022) | 3 | 3 | 1 | 1 | 40% |
| (Herrmann-Werner et al., 2021) | 1 | 1 | 1 | 3 | 25% |
| (Tamayo et al., 2019) | 1 | 3 | 1 | 1 | 25% |
| (Ayedoun et al., 2020) | 3 | 1 | 1 | 1 | 25% |

In order to summarise the phases that were developed as part of the data extraction process, Figure 1 shows the PRISMA flowchart, detailing the number of manuscripts identified in each of the phases.

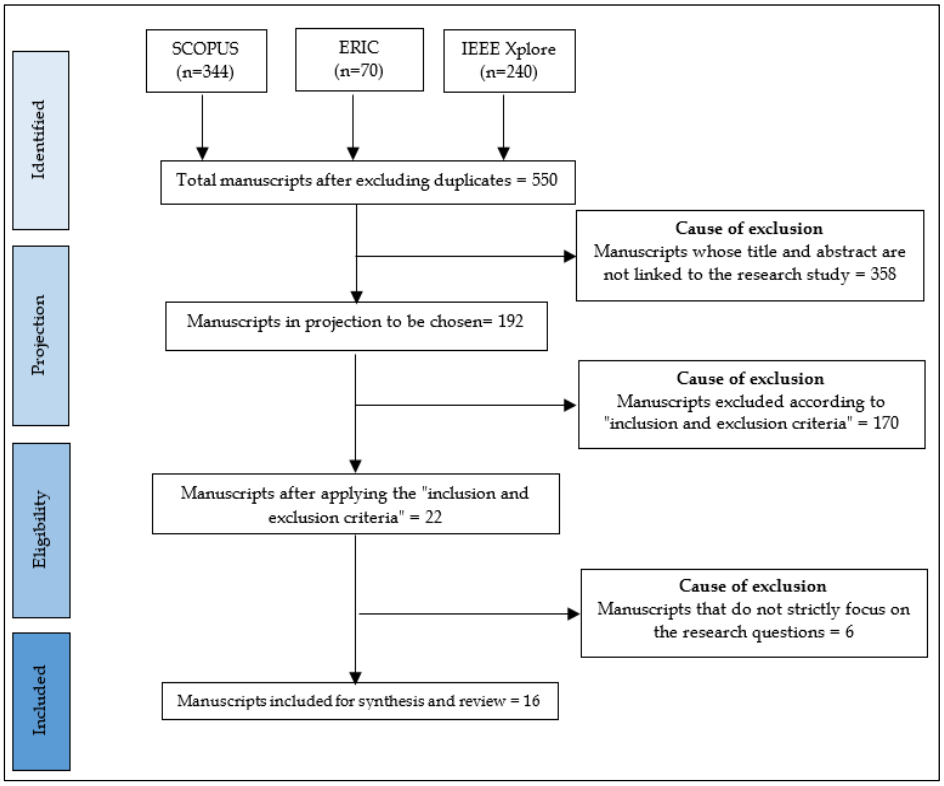


**Figure 1. Data extraction through the PRISMA declaration flow**

## 3. Results and discussion

Regarding the manuscripts included for the systematic review, Figure 2 shows the percentage distribution of the number of manuscripts by year of publication, taking into account that the period defined for this study is covers the years 2020, 2021 and 2022. As can be seen, there is a growing trend in scientific publications regarding chatbot applications in university education, in which the acceptance of its use and its impact on learning in the COVID-19 scenario are evident.

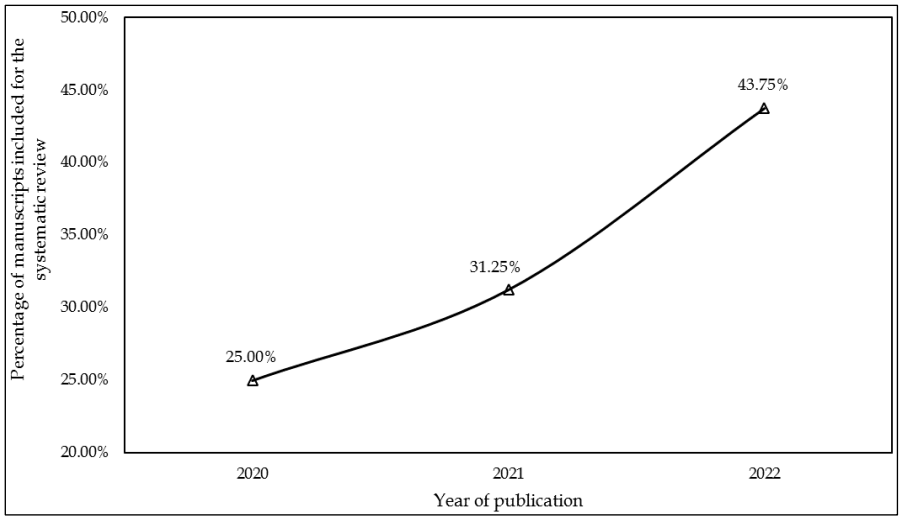


**Figure 2. Percentage distribution of manuscripts included for the systematic review, by year of publication**

Table 4 details the title of the manuscript, the study population, and the country in which the research published in the manuscripts included in this systematic review was addressed. Regarding the study population considered in the manuscripts, it was possible to identify that 81.25% of the manuscripts considered only undergraduate university students as the study population, while 18.75% considered undergraduate and postgraduate students as the study population.

**Table 4: Manuscripts included for the systematic review**

| References | Title of articles and conferences | Study population | Country |
|---|---|---|---|
| (Yin & Satar, 2020) | English As A Foreign Language Learner Interactions with Chatbots: Negotiation for Meaning | Undergraduate and graduate students | Egypt |
| (Vanichvasin, 2021) | Chatbot Development as a Digital Learning Tool to Increase Students' Research Knowledge | Bachelor students | Thailand |
| (Neo, 2022) | The Merlin Project: Malaysian Students' Acceptance of An Ai Chatbot In Their Learning Process | Bachelor students | Malaysia |
| (Çakmak, 2022) | Chatbot-Human Interaction and Its Effects on EFL Students' L2 Speaking Performance and Anxiety | Bachelor students | Turkey |
| (Chang et al., 2022) | Chatbot facilitated Nursing Education: Incorporating a Knowledge Based Chatbot System into a Nursing Training Program | Bachelor students | Taiwan |

| | | | |
|---|---|---|---|
| (Abbas et al., 2022) | Online chat and chatbot to enhance mature student engagement in higher education | Undergraduate and graduate students | England |
| (Essel et al., 2022) | The impact of a virtual teaching assistant (chatbot) on students' learning in Ghanaian higher education | Bachelor students | Ghana |
| (Yin et al., 2021) | Conversation Technology With Micro-Learning: The Impact of Chatbot-Based Learning on Students' Learning Motivation and Performance | Bachelor students | China |
| (Mellado-Silva et al., 2020) | Effective Learning of Tax Regulations using Different Chatbot Techniques | Bachelor students | Chili |
| (Uceda et al., 2021) | Chatbot as a remote learning self-regulation strategy in pandemics times | Bachelor students | Peru |
| (Al Kahf et al., 2023) | Chatbot-based serious games: A useful tool for training medical students? A randomized controlled trial | Bachelor students | France |
| (Malik et al., 2021) | Adoption of Chatbots for Learning among University Students: Role of Perceived Convenience and Enhanced Performance | Bachelor students | India |
| (Vázquez-Cano et al., 2021) | Chatbot to improve learning punctuation in Spanish and to enhance open and flexible learning environments | Bachelor students | Spain |
| (Ren et al., 2022) | Using the PARTNER Chatbot for UML Modeling: A Second Family of Experiments on Usability in Academic Settings | Bachelor students | Ecuador |
| (Almahri et al., 2020) | Understanding Student Acceptance and Use of Chatbots in the United Kingdom Universities: A Structural Equation Modeling Approach | Undergraduate and graduate students | England |
| (Lee et al., 2020) | Using a Multiplatform Chatbot as an Online Tutor in a University Course | Bachelor students | China |

### 3.1 Motivations that led to the use of the chatbot in university education in the context of COVID-19

Regarding the first research question, regarding the motivations that led to the use of the chatbot in university education, it was possible to identify that these can be grouped into four categories, namely: “Lack of student interaction”, “Lack of student motivation”, “Lack of tools for learning” and “Lack of teaching strategies”. Of the total manuscripts reviewed, 43.75% indicated that they used a

chatbot in university education due to the lack of interaction between students, while 37.50% used it due to the lack of tools for learning. Thus, it was also possible to identify that. to a lesser extent. they used the chatbot to solve problems related to the lack of teaching strategies and student motivation, which in percentages represent 12.50% and 6.25%, respectively. It is clear that what has been indicated makes references to studies published in the period in which university education was immersed in the context of the COVID-19 pandemic. Figure 3 shows the percentage distribution of manuscripts grouped by category with respect to the reason that led to the use of the chatbot.

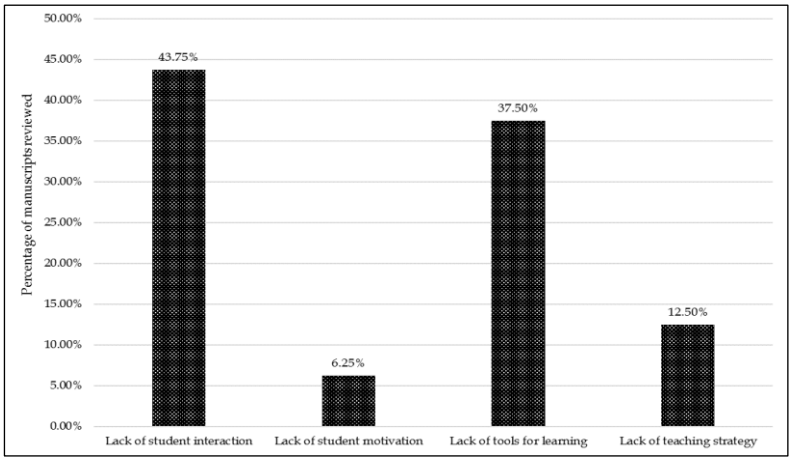


**Figure 3. Percentage distribution of manuscripts grouped by category regarding the justification that motivated the use of the chatbot**

In addition, González et al. (2020) point out that technological tools based on chatbot have been developed that are currently used and contribute to the improvement of education, namely: Virtual Class Assistant (VLA), Intelligent Tutor System (IGS), Companion System Learning Objects (LCS) and Learning Objects (LO). In this sense, for each study reviewed, Table 5 details the category regarding the motive or reason that led to the use of the chatbot. In addition, the study problem that is intended to be solved from the use of the chatbot in university education is specified. Finally, the category is detailed regarding the type of tool developed with the chatbot.

**Table 5: Categorisation of the motivations that led to the use of the chatbot**

| Categorisation of the reason that led to the use of the chatbot | Problems that are intended to be solved with the chatbot | Technological tools based on chatbot | Reference |
|---|---|---|---|
| Lack of student interaction | The lack of student interaction causes dissatisfaction in learning a second language. | VLA | (Yin & Satar, 2020) |
| | Lack of student interaction causes poor performance in nursing training courses. | VLA | (Chang et al., 2022) |

| | | | |
|---|---|---|---|
| | The lack of interaction in the students causes a low performance in the oral communication of a second language. | LCS | (Çakmak, 2022) |
| | The lack of interaction of the students generates dissatisfaction in learning in online courses. | LCS | (Abbas et al., 2022) |
| | The lack of interaction of the students caused a low academic performance in the multimedia programming course. | LCS | (Essel et al., 2022) |
| | Lack of personalised learning support for research. | IGS | (Vanichvasin, 2021) |
| | The lack of interaction of the students generates dissatisfaction in learning a second language. | IGS | (Ren et al., 2022) |
| Lack of tools for learning | The lack of tools for teaching caused a low performance in accounting students. | VLA | (Mellado-Silva et al., 2020) |
| | The lack of tools in teaching causes the abandonment of studying by law students. | VLA | (Uceda et al., 2021) |
| | The lack of a tool generates dissatisfaction in computer science students for not obtaining answers to the questions generated during classes. | VLA | (Lee et al., 2020) |
| | The lack of teaching tools causes low performance in undergraduate students. | IGS | (Malik et al., 2021) |
| | The lack of tools causes low performance in students in a virtual environment with respect to a second language. | IGS | (Vázquez-Cano et al., 2021) |
| | The lack of learning tools causes dissatisfaction in the learning of computer science students. | IGS | (Almahri et al., 2020) |
| Lack of teaching strategies | The lack of teaching strategies causes poor performance in final exams. | VLA | (Al Kahf et al., 2023) |
| | The lack of strategy in teaching causes a deficit in the retention of students in their online courses. | VLA | (Neo, 2022) |
| Lack of student motivation | The lack of motivation causes low academic performance in undergraduate students. | IGS | (Yin et al., 2021) |

Furthermore, Table 6 shows a cross-tabulation analysis between the categories corresponding to the reason that led to the use of the chatbot and the categories regarding the technological tool based on the chatbot used in university education. From the findings, it shows that the reason of using chatbot in university education was the problem related to the lack of student interaction, representing 43.8% of the total manuscripts reviewed. In addition to this percentage, 18.7% used the chatbot as an LCS tool, while 12.5% used the chatbot as a VLA tool and the same percentage used it as an IGS tool. On the other hand, it was possible to identify that, to a lesser extent, the reason that led to using chatbot in university education was problems related to the lack of student motivation, representing 6.3% of the total manuscripts reviewed. In this case, all the manuscripts used the chatbot as an IGS tool.

**Table 6: Result of the cross-tab analysis between the categories of the reasons that led to the use of the chatbot and the technological tools based on the chatbot**

| | | Categories regarding chatbot-based technological tools | | | Total |
|---|---|---|---|---|---|
| | | VLA | LCS | IGS | |
| Categories of the reasons that led to the use of the chatbot | Lack of student interaction | 12.5% | 18.7% | 12.5% | 43.7% |
| | Lack of tools for learning | 18.8% | 0.0% | 18.7% | 37.5% |
| | Lack of teaching strategies | 12.5% | 0.0% | 0.0% | 12.5% |
| | Lack of student motivation | 0.0% | 0.0% | 6.3% | 6.3% |
| Total | | 43.8% | 18.7% | 37.5% | 100% |

Thus, in relation to the results obtained regarding the motivations that led to the use of the chatbot in university education in the context of COVID-19, Torres (2021) point out that it is important to develop applications such as conversational agents or chatbots because these contribute to the improvement of the teaching and learning process, since it is a sector little explored in these years and that benefit could be taken from them to solve various problems in education. Likewise, Asencio (2021) in his research on the use of a chatbot as a self-regulation strategy for remote learning in times of pandemic, points out that, due to the need to improve some aspects in the field of higher education such as communication, learning, the accompaniment and support to the student, it is necessary to use the chatbot technology to improve the learning experience of university students. In addition, Sixtos (2021), in his study carried out on the support of teacher/student interactions through chatbots, points out that the crisis of the COVID-19 pandemic seriously affected the educational area, and that, despite the use of tools for videoconferences and for online class management, these systems do not provide all the necessary tools for proper

interaction and communication between the actors involved in the teaching-learning process, which makes the use of chatbots relevant. These positions established by the cited authors support the reasons identified in this systematic review regarding what were the reasons that led to the use of the chatbot in university education in the context of COVID-19. Although not all of these cited studies mention all the reasons that were identified, they do so as a whole, which is why they support the results found with respect to this first research question.

### 3.2 Criteria used to assess the acceptance of the chatbot in university education, in the context of COVID-19

Regarding the criteria used to evaluate the acceptance of the use of the chatbot in university education in the context of COVID-19, it was possible to identify in the reviewed manuscripts that the following criteria were used: "chatbot design", "chatbot interface" and "chatbot responsiveness". In addition, the criterion used to a greater extent to evaluate the acceptance of this tool is chatbot responsiveness", as identified in 37.50% of the reviewed manuscripts. Thus, it was also identified that the criteria "chatbot design" and "chatbot interface" were used in 31.25% of the manuscripts reviewed, that is, both criteria were used with the same percentage. Figure 4 shows the criteria used to assess the acceptance of the chatbot in university education.

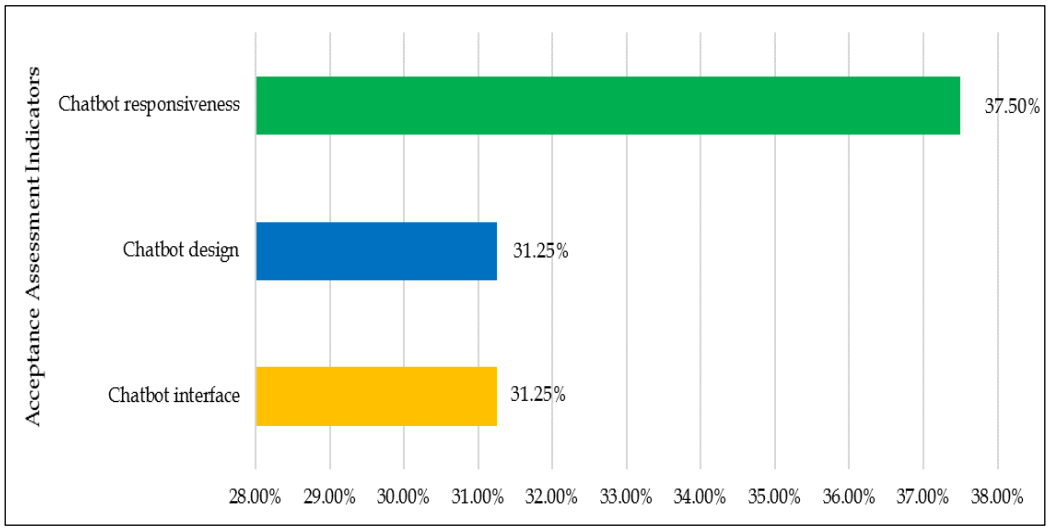


**Figure 4. Distribution of the criteria used to assess the acceptance of the chatbot in university education by percentage**

However, a more exhaustive study should be carried out regarding the evaluation criteria used to evaluate the acceptance of the chatbot, to consider Castillo et al.'s (2021) classification of the types of chatbot as "Task Oriented (TO)" and "Non-task oriented (NTO)". Table 7 details the criteria used to assess acceptance of the use of the chatbot for each study reviewed, as well as the degree of acceptance that was obtained and the type of chatbot that was used.

**Table 7: Criteria used to assess the acceptance of the chatbot**

| Criteria used to evaluate the acceptance of the use of the chatbot | Degree of Acceptance | Chatbot type | Reference |
|---|---|---|---|
| Chatbot design | Undergraduate students found themselves interested and enjoying the chatbot design with a mean of 4.63 and a standard deviation of 0.91. | TO | (Yin et al., 2021) |
| | Computer science students mentioned that there is significant satisfaction in the design of the chatbot, which motivates them to have more interaction among themselves. | TO | (Ren et al., 2022) |
| | Regarding the design of the chatbot, undergraduate students are satisfied, obtaining an average of 5 and a standard deviation of 0. | NTO | (Vanichvasin, 2021) |
| | 77.3% of undergraduate students interacted with the chatbot design and indicated that they were satisfied with said design. | NTO | (Almahri et al., 2020) |
| | The students were satisfied with the design of the chatbot, obtaining an average of 3.89. | NTO | (Çakmak, 2022) |
| Chatbot interface | 81.4% of students were satisfied with the interaction of the interface | TO | (Neo, 2022) |
| | 70% of students were attracted to the chatbot interface, so they used it again for their medical learning | TO | (Al Kahf et al., 2023) |
| | Nursing students were satisfied with the chatbot interface, obtaining a mean of 4.19 and a standard deviation of 0.72. | NTO | (Chang et al., 2022) |
| | Undergraduate students were satisfied with the chatbot interface, which helped them in their learning in finance. | NTO | (Yin & Satar, 2020) |
| | The students were satisfied with the chatbot interface, which helped them in their learning in a second language, obtaining a mean variance of 0.667 compared to the control group of 0.005. | NTO | (Vázquez-Cano et al., 2021) |
| Chatbot responsiveness | 79% of the students indicated that the chatbot was focused on their learning since the answers it provided were clear and simple. | TO | (Essel et al., 2022) |
| | Students had significant satisfaction in the answers provided by the chatbot, since it helped them in their learning in law. | TO | (Uceda et al., 2021) |
| | Undergraduate students were satisfied with the answers provided by the chatbot | TO | (Malik et al., 2021) |

| | | | |
|---|---|---|---|
| | with a mean variance of 0.72. | | |
| | 66.7% of the students were satisfied with the answers provided by the chatbot, which helped them in learning in the accounting career. | NTO | (Ren et al., 2022) |
| | 59% of undergraduate students recommended the use of the chatbot since its responses are precise and immediate. | NTO | (Abbas et al., 2022) |
| | 70% of computer science students indicated that the chatbot answered their questions, so they were satisfied with it. | NTO | (Lee et al., 2020) |

Based on the above, cross-tabulation analysis was performed between the evaluation criteria and thus Table 8 was obtained, which represents the results obtained from the analysis between the criteria used to evaluate the acceptance of the chatbot and the type of chatbot used in university education in the context of COVID-19. It was identified that 56.25% of the investigations used a non-task-oriented (NTO) chatbot, while 43.75% made use of a task-oriented (TO) chatbot. In addition to the 56.25% of investigations that used the NTO-type chatbot, 18.8% used the "chatbot design" as an acceptance evaluation criterion, as well as 18.75% used the "chatbot responsiveness" as a criterion to evaluate acceptance, while 18.70% used the "chatbot interface" as a criterion.

**Table 8. Cross-tabulation analysis between the type of chatbot and its acceptance criteria**

| | | Chatbot type | | Total |
|---|---|---|---|---|
| | | NTO | TO | |
| Evaluation criteria | Chatbot design | 18.80% | 12.50% | 31.25% |
| | Chatbot interface | 18.70% | 12.50% | 31.30% |
| | Chatbot responsiveness | 18.75% | 18.75% | 37.50% |
| | Total | 56.25% | 43.75% | 100.00% |

So, in relation to the results obtained regarding the criteria used to evaluate the acceptance of the use of the chatbot in university education in the context of COVID-19, Moína, and Loaiza (2019) evaluated the acceptance of the chatbot when applying it to the context of the higher education, for which they used the effectiveness of the answers delivered by the chatbot as an evaluation criterion, by which they obtained results that helped to identify the degree of operation of the tool based on artificial intelligence. Along the same line of opinion, Melo (2020), in his research on a virtual learning management framework developed by artificial intelligence immersed in a chatbot, concluded that the agent used optimises response times, as well as conversation quality; Therefore, it can be deduced that the chatbot's responsiveness is adopted as a criterion to evaluate, thereby establishing the degree of acceptance among students. On the other hand, showing other indicators to evaluate, Llugcha (2023), in his research on chatbots applied to the academy's tutoring of the mathematics course, made use of a technological acceptance model (TAM) with the purpose of identifying acceptance of the use of the chatbot, by which he was able to focus on criteria

such as utility, ease of use, perceived activity and the intention to use the chatbot. Based on what has been stated, it can be established that these studies support what was identified in this systematic review, this by noting that the "response capacity of the chatbot" has been used to a greater extent to assess its acceptance. However, it should be noted that there is no rigidity regarding the mandatory use of certain criteria, so the choice of these will depend on what is intended to be improved or optimised.

### 3.3 Impact on learning when using chatbot in university education in the context of COVID-19

In relation to the research question RQ3, regarding the impact generated by the chatbot in university education, initially we proceeded to identify which indicators were used in each manuscript to demonstrate the impact specifically on the learning variable, therefore, reviewing the 16 manuscripts it was possible to establish that these are: interaction between students and teacher, retention, speaking performance, academic performance, dropout and student satisfaction. In addition, when analysing which indicator was used to a greater extent to identify the impact on learning, it was identified that it was "academic performance", being used in 41.18% of the total manuscripts reviewed. Meanwhile, the manuscripts that used "interaction" and "student satisfaction" to demonstrate the impact of the chatbot on learning presented the same percentage, equal to 17.65%. Finally, the manuscripts that used "retention", "speaking performance" and "student dropout" as indicators each represent 5.88%. Table 9 details the indicator used to demonstrate the impact of using the chatbot on learning for each study reviewed, as well as the improvement result obtained.

**Table 9: Indicators and their impact on learning when using chatbot in university education**

| Indicators that show the impact of the chatbot | Impact generated | Reference |
|---|---|---|
| Interaction between students and teacher | Through the chatbot, undergraduate students show an increase in the interaction between them and the teacher, since it allows them to learn a second language. However, postgraduate students do not show a significant increase in the interaction between them and the teacher, so they do not observe significant results in the learning of the second language. | (Yin & Satar, 2020) |
| | Undergraduate students show an increase in the interaction between them thanks to the use of the chatbot, which allows them to improve their learning in the area of research. The general mean of improvement obtained is 4.39 with a standard deviation of 0.69. | (Vanichvasin, 2021) |
| | 63% of undergraduate and graduate students show an increase in their participation in a virtual environment between themselves and teachers, | (Abbas et al., 2022) |

| | | |
|---|---|---|
| | thanks to the use of the chatbot. | |
| Retention | 70.6% of undergraduate students show an increase in their learning retention from online courses through the use of the chatbot. | (Neo, 2022) |
| Communication | Through the chatbot, 93.3% of undergraduate students improved their lack of oral communication in English. | (Çakmak, 2022) |
| Academic performance | By using the chatbot in the experimental group, the students improved their academic performance compared to the control group, with an average of 86.77 and 63.45, respectively. In the same way, regarding critical thinking, the experimental group obtained an average of 3.99 and the control group an average of 2.92. | (Chang et al., 2022) |
| | Students improved their motivation towards study, as evidenced in the results of a perceived lesson greater than 5.1. However, there was no significant improvement in their academic performance when using the chatbot. | (Yin et al., 2021) |
| | By interacting with the chatbot, the students improved their academic performance, since previously there was a performance of 40.6%. After applying the chatbot, they obtained 81.1%, which represents an improvement of 40.5%. | (Essel et al., 2022) |
| | Through the chatbot, undergraduate students improved their academic performance, resulting in an increase of 14.65%. | (Mellado-Silva et al., 2020) |
| | Teachers improved their teaching strategy through the use of the chatbot. They used the chatbot to answer questions in a timely manner from the students. As a result of the application, undergraduate medicine students increased their academic performance, achieving 88.8% success in their final exams. | (Al Kahf et al., 2023) |
| | The contribution of the chatbot in student learning resulted in an improvement in academic performance, with a mean variance of 0.78. | (Malik et al., 2021) |
| | The chatbot's contribution to learning a second language, such as English, allowed undergraduate students to improve their academic performance. The results of the experimental group obtained a mean of 32.13, while the control group had a mean of 28.47. | (Vázquez-Cano et al., 2021) |
| Student dropout | Through the chatbot, 96.1% of undergraduate students managed to control their negative emotions in a virtual environment, which resulted in a dropout decrease of 8.29%. | (Uceda et al., 2021) |
| Student satisfaction | Through the chatbot, undergraduate students were satisfied with the chatbot application, which resulted in an 8.9% improvement in learning a second language such as English. | (Ren et al., 2022) |

| | | |
|---|---|---|
| | Through the chatbot, undergraduate and graduate students were satisfied with the use of the chatbot, since they experienced an improvement in their learning, with a mean variance extracted (AVE) of 0.78. | (Almahri et al., 2020) |
| | Through the chatbot, 70% of undergraduate students were satisfied with the chatbot interface since it motivated them to ask more questions in class. | (Lee et al., 2020) |

Based on these results, it can be established categorically and concretely that the application of the chatbot in university education generates a positive impact. Although this impact occurs in learning, the impact is not only measured through the improvement of academic performance, but also through other indicators such as interaction between students and teachers, retention, speaking performance, dropout and student satisfaction. In this regard, Arias-Navarrete et al. (2020), in their study on the integration of a chatbot to an LMS as an assistant for learning management, concluded that the inclusion of a comprehensive system that includes data analysis, decision-making through interaction of the student with a chatbot allows to generate a positive impact, significantly improving learning. Regarding this appreciation, we agree that the indicator "student interaction" is a relevant aspect to demonstrate the impact of the chatbot on learning. In addition, Asencio (2020), in his research on the application of the chatbot as a strategy for self-regulation of learning in the context of the COVID-19 pandemic, was able to show that using chatbots with high usability rates increased student self-regulation, by which it is considered that this positive impact validates that universities need to have innovative digital tools, such as chatbots, that contribute to educational quality and also reduce dropout rates. Based on what the author pointed out, it is notable that he used student dropout as an indicator to assess the impact on learning, so we agree that the chatbot generates a positive impact on university education. On the other hand, in his systematic review study on the chatbot in university education, Auqui (2021) concluded that the main impact indicators produced by the development of a chatbot in the university learning process are personalised attention, flexibility, availability, data analysis and scalability. With respect to this appreciation, we disagree since the indicators to which it refers are more related to the advantages or benefits that this type of tool offers to the user, but are not closely linked to the learning variable.

## 4. Conclusion

Based on the results obtained in seeking to answer the research questions established in this systematic review, regarding identifying and describing the acceptance of the use of the chatbot and its impact on learning in university education in the context of COVID-19, it is concluded that the motivations that led to the use of the chatbot in university education are: the lack of student interaction, the lack of student motivation, the lack of tools for learning and the lack of teaching strategies; the lack of student interaction being the reason or motive that was identified to a greater extent in the reviewed manuscripts. “Design of the chatbot", "interface of the chatbot" and "response capacity of the

chatbot" are the criteria used to evaluate the acceptance of the use of the chatbot in university education amidst COVID-19. The latter being the criterion that was used to a greater extent in the studies evidenced in the reviewed manuscripts. In addition, it is established that applying chatbots in university education generated a positive impact on learning, in the context of the pandemic and social isolation. Although this impact was analysed in learning, it is not only evidenced in the improvement of academic performance, but also through other indicators such as the improvement in the interaction between students and teachers, retention, speaking performance, dropout and student satisfaction. Therefore, the acceptance of the use of the chatbot and the positive impact generated on learning, in university education during the context of COVID-19, should lead to reflection in this post-pandemic scenario on the integration of artificial intelligence tools such as the chatbot into traditional educational environments, transforming the way in which teaching and learning are taught, providing new opportunities for educational growth, under a more flexible and personalised learning.

## 5. Limitation of the study

It is important to point out that this study focused on the analysis of the acceptance and impact of the chatbot on learning in university education and in the context of the COVID-19 pandemic; therefore it was limited to focusing on scientific evidence related to the strictly educational field. In other words, in this study, the tools used for the implementation of the chatbot were not considered, nor how they are integrated into social networks for use in the university educational field. Therefore, it is recommended that the issues not addressed in this review article be considered in future studies.

## 6. References

Abbas, N., Whitfield, J., Atwell, E., Bowman, H., Pickard, T., & Walker, A. (2022). Online chat and chatbots to enhance mature student engagement in higher education. *International Journal of Lifelong Education*, *41*(3), 308–326. https://doi.org/10.1080/02601370.2022.2066213

Al Kahf, S., Roux, B., Clerc, S., Bassehila, M., Lecomte, A., Moncomble, E., Alabadan, E., de Montmolin, N., Jablon, E., François, E., Friedlander, G., Badoual, C., Meyer, G., Roche, N., Martin, C., & Planquette, B. (2023). Chatbot-based serious games: A useful tool for training medical students? A randomized controlled trial. *Plos One*, *18*(3), 1–12. https://doi.org/10.1371/journal.pone.0278673

Albizu, A. L. G. de. (2019). *Design proposal for an informative chatbot for the population about the flu* [Bachelor's Thesis, Public University of Navarre]. https://hdl.handle.net/2454/33342

Almahri, F. A. J., Bell, D., & Merhi, M. (2020). *Understanding student acceptance and use of chatbots in the United Kingdom universities: A structural equation modelling approach*. Paper presented at the 6th IEEE International Conference on Information Management, ICIM 2020. https://doi.org/10.1109/ICIM49319.2020.244712

Arias-Navarrete, A. S., Palacios-Pacheco, X. I., & Villegas-Ch, W. (2020). Integration of a chatbot to an LMS as an assistant for learning management. *Iberian Journal of Information Systems and Technologies*, *E32*, 164–175.

Arias-Navarrete, A. S., Palacios-Pacheco, X. I., & Villegas-Ch, W. (2020). Integration of a chatbot to an LMS as an assistant for learning management. *Iberian Journal of Information Systems and Technologies*, (E32), 164-175.

Asencio, G. A. C. (2021). *Chatbot as a self-regulation strategy for remote learning in times of pandemic* [Bachelor's thesis, North Private University]. https://hdl.handle.net/11537/27977

Auqui, J. A. O. (2021). Chatbot of the university learning process: A systematic review. *Alpha Centauri Journal of Scientific and Technological Research, 2*(2), 29-43.

Ávila, C. L., & Gómez, S. B. (2017). Gamification in higher education: a systematic review. *Engineering Journal University of Medellín*, *16*(31), 97–124. https://doi.org/10.22395/rium.v16n31a5

Ayedoun, E., Hayashi, Y., & Seta, K. (2020). Toward Personalized Scaffolding and Fading of Motivational Support in L2 Learner-Dialogue Agent Interactions: An Exploratory Study. *IEEE Transactions on Learning Technologies*, *13*(3), 604–616. https://doi.org/10.1109/TLT.2020.2989776

Ayuso-del Puerto, D., & Gutiérrez-Esteban, P. (2022). Artificial Intelligence as an Educational Resource during Preservice Teacher Training. *Ibero-American Journal of Distance Education*, *25*(2), 347–362. https://doi.org/10.5944/ried.25.2.32332

Bailey, D., & Almusharraf, N. (2021). *Investigating the Effect of Chatbot-to-User Questions and Directives on Student Participation*. Paper presented at the 1st International Conference on Artificial Intelligence and Data Analytics, CAIDA 2021. https://doi.org/10.1109/CAIDA51941.2021.9425208

Bonales, G., Pradilla, N., & Citlali, E. (2020). Chatbot as a communication tool during the COVID-19 health crisis in Spain. *Comhumanitas Journal*, *11*(3), 1–22. https://doi.org/10.31207/rch.v11i3.270 Chatbot

Çakmak, F. (2022). Chatbot-human interaction and its effects on EFL students' l2 speaking performance and anxiety. *Novitas-ROYAL*, *16*(2), 113–131.

Castillo, L. R. M., Herrera, C. A. B., Martínez, M. R., & Solís, L. S. (2021). Chatbot about Healthy Eating. In G. T. R. Linares (Ed.), *Contributions of Computational Sciences During the COVID 19 Pandemic* (pp. 8-16). Benemérita Autonomous University of Puebla.

Castrillón, O. D., Sarache, W., & Ruiz-Herrera, S. (2020). Prediction of academic performance using artificial intelligence techniques. *University Education*, *13*(1), 93–102. https://doi.org/10.4067/s0718-50062020000100093

Chang, C. Y., Kuo, S. Y., & Hwang, G. H. (2022). Chatbot-facilitated nursing education: Incorporating a knowledge based chatbot system into a nursing training program. *Educational Technology and Society*, *25*(1), 15–27.

Collazos, L. F. M., & Estupiñan, C. A. Y. (2021). *Query response-based chatbot prototype as an educational tool for sexually transmitted infections (STIs) for students of the Francisco José de Caldas District University*. [Bachelor's Thesis, Francisco José de Caldas District University]. http://hdl.handle.net/11349/29588

Díaz, J. M. (2020). Artificial intelligence and big data as solutions to COVID-19. *Bioethics and Law Journal*, *50*, 315–331.

Essel, H. B., Vlachopoulos, D., Tachie-Menson, A., Johnson, E. E., & Baah, P. K. (2022). The impact of a virtual teaching assistant (chatbot) on students' learning in Ghanaian higher education. *International Journal of Educational Technology in Higher Education*, *19*(1). https://doi.org/10.1186/s41239-022-00362-6

Flores, V. J. J., Flores, O. J. J., Flores, J. C. J., & Castilla, J. U. J. (2020). Business chatbot for customer service at José Carlos Mariátegui University, 2019-II. *Neumann Business Review*, *6*(1), 91–104. https://doi.org/10.22451/3006.nbr2020.vol6.1.10047

Galindo-Monfil, A. R., Ortiz- Hernández, G., Martínez- Herrera, B. M., & Gálvez-Vázquez, M. Á. (2022). Chatbots as Support for Academic Tutorials in the Bachelor's Degree in Administrative Computing Systems of the Universidad

Veracruzana Xalapa Region. *Interconnecting Knowledge*, *14*, 55–64. https://doi.org/10.25009/is.v0i14.2760

Giró-Gracia, X., & Sancho-Gil, J. M. (2022). Artificial intelligence in education: Big data, black boxes, and technological solutionism. *Latin American Journal of Educational Technology*, *21*(1), 129–145. https://doi.org/10.17398/1695-288x.21.1.129

Gómez, L. J. S. (2022). *The future of higher education, a look from artificial intelligence*. Paper presented at the XVII International Congress on the Competency-Based Approach CIEBC2022. https://editorialcimted.com/wp-content/uploads/2022/07/Los-retos-de-la-educación-en-tiempos-de-pandemia.pdf#page=103

González, R. A. G., & Bonilla, M. H. S. (2022). Education and artificial intelligence: Immersive theme nodes. *Electronic Journal of Educational Technology*, *82*, 59–77. https://doi.org/10.21556/edutec.2022.82.2633

Guerrero-Bocanegra, B. (2022). Frequent topics in the reception forums for the development of a chatbot for initial university orientation. *Journal of Psychology and Education*, *17*(2), 187–197. https://doi.org/10.23923/rpye2022.02.225

Guevara-Herrero, I., Pérez-Martín, J. M., & Bravo-Torija, B. (2023). Impact of the sustainable development goals on educational research on environmental education. *Eureka Journal on Teaching and Dissemination of Sciences*, *20*(2), 1–18. https://doi.org/10.25267/Rev_Eureka_ensen_divulg_cienc.2023.v20.i2.2501

Herrmann-Werner, A., Loda, T., Junne, F., Zipfel, S., & Madany Mamlouk, A. (2021). "Hello, My Name Is Melinda" – Students' Views on a Digital Assistant for Navigation in Digital Learning Environments; A Qualitative Interview Study. *Frontiers in Education*, *5*(January), 1–7. https://doi.org/10.3389/feduc.2020.541839

Lee, L. K., Fung, Y. C., Pun, Y. W., Wong, K. K., Yu, M. T. Y., & Wu, N. I. (2020*). Using a multiplatform chatbot as an online tutor in a university course.* Paper presented at the Proceedings - 2020 International Symposium on Educational Technology, ISET 2020. https://doi.org/10.1109/ISET49818.2020.00021

León-Granizo, O., & León-Granizo, M. (2020). Development of a virtual assistant (chatbot) to improve access to recur- ring information by students of Higher Education Institutions. *Ecuadorian Science Journal*, *4*(2), 111–116. https://doi.org/10.46480/esj.4.2.49

Llugcha, N. F. J. (2023). *The CHATBOT in the academic tutoring of mathematics in the students of upper basic general education of the Private Educational Unit "Ricardo Descalzi" of the Ambato canton* [Bachelor's thesis, Technical University of Ambato]. https://repositorio.uta.edu.ec/jspui/handle/123456789/37295

Llugsa, D. A. M., & Vaca, J. E. J. (2022). Chatbot a customer service tool in times of COVID-19: a theoretical approach. *Digital Journal of Science, Technology and Innovation*, *9*(3), 327–350.

Maita-Cruz, Y. M., Flores-Sotelo, W. S., Maita-Cruz, Y. A., & Cotrina-Aliaga, J. C. (2022). Artificial intelligence in public management in times of Covid-19. *Social Science Journal*, *28*(5), 331–340. https://doi.org/10.31876/rcs.v28i.38167

Malik, R., Sharma, E. A., Trivedi, S., & Mishra, R. (2021). Adoption of chatbots for learning among university students: Role of perceived convenience and enhanced performance. *International Journal of Emerging Technologies in Learning*, *16*(18), 200–212. https://doi.org/10.3991/ijet.v16i18.24315

Martín-Ramallal, P., Merchán-Murillo, A., & Ruiz-Mondaza, M. (2022). Virtual trainers with artificial intelligence: degree of acceptance among university students. *Educar*, *58*(2), 427–442. https://doi.org/10.5565/rev/educar.1482

Mata, L. M., & Dávila, C. Á. (2020). BOT0210, a support tool for teaching. The experience of the Information Technologies Chair at UNED, Costa Rica. *Educational Innovations Journal*, *22*, 188–199. https://doi.org/10.22458/ie.v22iespecial.3196

Maydalis, H.P., & Llula Céspedes, L.A. (2021). Definition of an engineering process for the development of a chatbot based on established good practices. *Cuban Journal of Digital Transformation*, *2*(3), 90–109. https://doi.org/10.5281/zenodo.5546033

Mazón, R. M. (2021). A Chatbot on Syntactic Issues: A Proposal for Innovative Help in the 1St Year of Baccalaureate Classroom. *Journal Center Associated to the UNED City of Ceramics*, *21*, 83–110. https://dialnet.unirioja.es/servlet/articulo?codigo=8400386

Mellado-Silva, R., Faúndez-Ugalde, A., & Blanco-Lobos, M. (2020). Effective learning of tax regulations using different chatbot techniques. *Advances in Science, Technology and Engineering Systems*, *5*(6), 439–446. https://doi.org/10.25046/aj050652

Melo, P. A. Ch. (2020). *Development of a virtual learning management framework to provide support to students through the use of an artificial intelligence technique immersed in a chatbot* [Bachelor's thesis, National Polytechnic School]. http://bibdigital.epn.edu.ec/handle/15000/20996

Méndez, E. A. P. (2021). *Development of a chatbot to support the programming learning process at UPS*. [Bachelor's Thesis, Salesian Polytechnical University]. http://dspace.ups.edu.ec/handle/123456789/22288

Miguel, M. C. (2021). *Chatbot Botseriu: Lessons learned and results of its application to university teaching*. Paper presented at the Proceedings of the III International Conference on Teaching Innovation and Research in Higher Education: Changes in the Teaching-Learning Process of the Knowledge Areas. https://indoc.uca.es/articulos/sol-201900138701-tra.pdf

Moína, K. L. H., & Loaiza, J. I. Z. (2019). *Development of a virtual web assistant for the EPN and a voice-directed assistant in the digital kiosks of the DGIP* [Bachelor's thesis, National Polytechnic School]. http://bibdigital.epn.edu.ec/handle/15000/20051

Neo, M. (2022). The Merlin project: Malaysian students' acceptance of an AI chatbot in their learning process. *Turkish Online Journal of Distance Education*, *23*(3), 31–48. https://doi.org/10.17718/tojde.1137122

Ocaña-Fernández, Y., Valenzuela-Fernández, L. A., & Garro-Aburto, L. L. (2019). Artificial intelligence and its implications in higher education. *Purposes and Representations*, *7*(2), 536–552. https://doi.org/10.20511/pyr2019.v7n2.274

Olivera, H. V., Maita, A. R. C., Flores, M. D. P., Chicata, J. R. V., Quille, R. V. E., Grover Enrique Castro Guzmán, Uscapi, Y. L., García, J. L. H., Cartagena, L. A. Q., & Rodas, L. E. (2021). Saminbot: A virtual assistant to collect data during the COVID-19 pandemic. *Interfases*, *14*, 138–162. https://doi.org/10.26439/interfases2021.n014.5451

Orozco, M.P., Pytel, P., & Pollo-Cattaneo, M. F. (2020). Implementation methodology of a chatbot as a virtual tutor in the educational field for universities in Latin America. In Serna, E.M. (Ed.), *Formative Research in Engineering* (pp. 218–226). Antioquia Research Institute (IAI).

Ponce, F. B. P., Caicedo, R. W. A., Parrales, K. G. M., & Plúa, C. R. C. (2022). Virtual assistant as a component for the development of an intelligent university in linkage processes at the State University of the South of Manabí. *RECIAMUC*, *6*(4), 191–199. https://doi.org/10.26820/reciamuc/6.(4).octubre.2022.191-199

Ren, R., Perez-Soler, S., Castro, J. W., Dieste, O., & Acuna, S. T. (2022). Using the SOCIO chatbot for UML modeling: A second family of experiments on usability in academic settings. *IEEE Access*, *10*, 130542–130562. https://doi.org/10.1109/ACCESS.2022.3228772

Rodríguez, R. E., Herrero, C. P. de C., Muñoz, M. del C. L., García, M. J. S., & Torres, I. H. P. (2018). Chatbots in social networks for the timely support of university students with attention-deficit/hyperactivity disorder symptoms Rubén. *Ibero-*

American Journal of Technology in Education and Education in Technology, 22, 52–62. https://doi.org/10.24215/18509959.22.e06

Roy, R., Babakerkhell, M. D., Mukherjee, S., Pal, D., & Funilkul, S. (2022). Evaluating the Intention for the Adoption of Artificial Intelligence-Based Robots in the University to Educate the Students. *IEEE Access*, *10*(October), 125666–125678. https://doi.org/10.1109/ACCESS.2022.3225555

Sixtos, V. H. E. (2021). *Support of teacher/student interactions through a chatbot* [Master's thesis, Center for Research and Advanced Studies of the IPN]. https://repositorio.cinvestav.mx/handle/cinvestav/3725

Tamayo, P. A., Herrero, A., Martín, J., Navarro, C., & Tránchez, J. M. (2019). Design of a chatbot as a distance learning assistant. *Open Praxis*, *12*(1), 145–153. https://doi.org/10.5944/openpraxis.12.1.1063

Toasa, J. S. Y. (2023). *State of the art on teaching evaluation using artificial intelligence techniques in the university education system*. [Bachelor's Thesis, Salesian Polytechnical University]. http://dspace.ups.edu.ec/handle/123456789/24412

Torres, J. C. (2021). *Training of a chatbot to assist in the teaching and correct use of the spelling of the Spanish language* [Master's thesis, National Technological of Mexico]. https://rinacional.tecnm.mx/jspui/handle/TecNM/4436

Torres, M. T. M., Álvarez, L. M. S., & Osorio, A. S. O. (2022). Initial study of a chatbot for virtual modality students from the inter-American school of librarianship. *Library Research*, *36*(90), 13–30. https://doi.org/10.22201/iibi.24488321xe.2022.90.58452

Uceda, P., Polo, L., & Cruzado, G. (2021). *Chatbot as a remote learning self-regulation strategy in pandemics times*. Paper presented at the 19th LACCEI International Multi-Conference for Engineering, Education, and Technology. https://doi.org/10.18687/LACCEI2021.1.1.327

Valles-Coral, M. A., Salazar-Ramírez, L., Injante, R., Hernandez-Torres, E. A., Juárez-Díaz, J., Navarro-Cabrera, J. R., Pinedo, L., & Vidaurre-Rojas, P. (2022). Density-Based Unsupervised Learning Algorithm to Categorize College Students into Dropout Risk Levels. *Data*, *7*(11), 1–18. https://doi.org/10.3390/data7110165

Valverde, R. Z. (2021). A look at the opportunities and threats of artificial intelligence in higher education. *Institutional Academic Journal*, *3*(2), 49–61.

Vanichvasin, P. (2021). Chatbot development as a digital learning tool to increase students' research knowledge. *International Education Studies*, *14*(2), 44–53. https://doi.org/10.5539/ies.v14n2p44

Vázquez-Cano, E., Mengual-Andrés, S., & López-Meneses, E. (2021). Chatbot to improve learning punctuation in Spanish and to enhance open and flexible learning environments. *International Journal of Educational Technology in Higher Education*. *18*, 1-20. https://doi.org/10.1186/s41239-021-00269-8

Vázquez-Cano, E., Mengual-Andrés, S., & López-Meneses, E. (2021). Chatbot to improve learning punctuation in Spanish and to enhance open and flexible learning environments. *International Journal of Educational Technology in Higher Education*, *18*, 1–20. https://doi.org/10.1186/s41239-021-00269-8

Vera, F. (2023). Integration of artificial intelligence in higher education: Challenges and opportunities. *Transform Electronic Journal*, *4*(1), 17–34.

Yin, J., Goh, T. T., Yang, B., & Xiaobin, Y. (2021). Conversation technology with micro-learning: The impact of chatbot-based learning on students' learning motivation and performance. *Journal of Educational Computing Research*, *59*(1), 154–177. https://doi.org/10.1177/0735633120952067

Yin, Q., & Satar, M. (2020). English as a foreign language learner interaction with chatbots: Negotiation for meaning. *International Online Journal of Education and Teaching*, *7*(2), 390–410. http://iojet.org/index.php/IOJET/article/view/707