Investigating the Use of Artificial Intelligence (AI) in Educational Settings: A Systematic Review

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Abstract. In recent years, Artificial Intelligence (AI) has witnessed significant progress. Some techniques like Natural Language Processing have been developed and improved, and the areas of AI application have been expanded. The use of AI-based technology is increasingly popular in many different environments. One of these environments is education, as it can also benefit from the advantages that AI offers. In this article, we research the application of Artificial Intelligence in the education field. Our systematic research has identified various studies that demonstrate multiple ways of applying AI-based tools in student learning environments. These various studies have been analysed, leading to the identification of reported advantages of AI in educational contexts. Interest in AI for education is significant, as AI holds substantial promise in terms of the learning experience and outcomes for participants.

Keywords: Artificial Intelligence · Education · Systematic review · Chatbot

1 Introduction

Artificial Intelligence (AI) has a profound impact on our daily life. Every day we have at our disposal virtual voice assistants, chatbots, tools for filtering incoming emails, recommendation systems used in social media networks or streaming platforms, etc. The applications mentioned are just an example of what the term Artificial Intelligence covers. The magnitude of the AI term can be appreciated when we search "Artificial Intelligence" on the Internet. AI is a part of computing dedicated to the development of algorithms allowing a machine to make smart decisions, or at least behave as if it had human intelligence. This is a very generic definition that encompasses different disciplines such as Robotics, Machine Learning, Diffuse Logic, and Natural Processing Language, among others. Each one with its own variants and applications.

Since the creation of the first robots able to perform some actions like humans, AI has been introduced into our daily life. Algorithms that use AI techniques are used in social

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media and online sales platforms. These kinds of tools not only automate or simplify daily actions, but can also be used to predict natural disasters, for example, to reduce occupational hazards, prevent acts of violence, predict possible illnesses, or improve teaching.

Chatbots are also becoming more common in daily life. The main advantage of chatbots is that their users have access to information, usually on a specific topic, without having to spend a lot of time searching and filtering data.

As AI has become a part of our lives, we might wonder if it can also positively change the traditional teaching methods. Some examples might be showing intelligent content to the students, offering them personalized learning, or improving efficiency in terms of the organization of a module or university course.

This article presents the results of research identifying existing AI applications in education. Our final goal is to get to know how Artificial Intelligence could support both Software Engineering students and teachers in adapting to the new educational format, which will further the interaction between students and teachers. The authors would like to research the benefits that AI can bring both to the students who are studying some Software Engineering courses and to the professors who teach its modules.

The rest of the paper is organized as follows. Section 2 describes the research method applied for performing the systematic review. Section 3 analyses the selected studies presenting AI-based tools used in education. Section 4 discusses the different AI implementations identified and presents some concluding remarks.

2 Research Method

This research was based on a systematic review of the literature according to the guidelines proposed by Kitchenham and the revision protocol template developed by Biolchini et al. [1]. The protocol used for the systematic review consisted of five stages: questions formulation, sources selection, studies selection, information extraction, and results summary. These five stages are detailed in the following sub-sections.

2.1 Question Formulation

To define the context in which the systematic review was performed, the protocol suggests specifying a set of items.

- *Question.* Which tools based on Artificial Intelligence have been applied in education?
- *Keywords and synonyms.* Artificial Intelligence, Intelligent Virtual Assistant.
- *Control.* There is no initial data for this systematic review.
- *Effects.* Identify existing applications of AI tools in education.
- *Population.* AI applications in education published in the list of sources selected to perform the systematic review.
- *Application.* Implementation of certain AI tools for enhancing software engineering education and training.
- *Experimental design.* No statistical analysis method is required to interpret the study's results.

A set of search strings listed in Table 1 was obtained from the definition of the keywords and combining it with the logical operators AND and OR.

Table 1. Search strings

ID	Search string
1	Artificial intelligence AND (Education OR higher education)
2	(Virtual assistant AND Education) OR (Chatbot AND Education)

2.2 Source Selection

The following criteria were defined to select the information sources where the searches for primary studies were performed:

- Editorials or websites recommended by experts.
- High-impact journals.
- Availability of keyword search engines.
- No variability in the results if one search is performed with the same keywords.
- Access from the Library and Documentation Service of the University of the Balearic Islands.
- Availability on the web.

Considering the selection criteria mentioned in the list above, the selected sources are listed in Table 2.

Table 2. Information sources

Information source	URL
ACM portal	https://portal.acm.org
IEEE Xplore	https://ieeexplore.ieee.org
ScienceDirect	https://www.sciencedirect.com
Springer link	https://link.springer.com
Google scholar	https://scholar.google.com

2.3 Study Selection

The studies identified during the search process were analysed to determine the suitability for the research performed. The selection process applied consisted of two phases:

- *Phase 1*. Analyse the studies that were found in the selected sources during the search process to select the primary studies.
- *Phase 2*. Examine the studies found and, based on these, search for other that were related to the primary study's authors, or with the subject they dealt with.

The criteria by which the studies were evaluated to decide whether to include or exclude them in the context of this review were defined considering the Kitchenham proposals [1]. The Inclusion Criteria (ICs) and Exclusion Criteria (ECs) are listed in Table 3.

Table 3. Definition of study inclusion and exclusion criteria

Criterion	Description
IC1	Include studies where the title is related to the use of Artificial Intnelligence in education
IC2	Include studies that contain keywords that match the search strings
IC3	Include studies with an abstract related to the application of AI in education
EC1	Exclude all duplicate studies
EC2	Exclude publications whose full text is unavailable

An overview of search results based on information sources is offered in Table 4.

Table 4. Results distribution by information source

Information source	Found	Relevant	Primary
ACM portal	17	12	2
IEEE Xplore	23	9	2
ScienceDirect	12	10	6
Springer link	4	2	1
Google Scholar	19	8	4
Total	**75**	**41**	**15**

2.4 Information Extraction

Once the 15 primary studies (references [3–17]) were selected, began the relevant information extraction. Table 5 defines the criteria to determine which information is relevant, which are the Information Inclusion Criteria (IC_{Inf}).

Table 5. Definition of information inclusion criteria

Criterion	Description
$IC1_{Inf}$	Identify AI-based technology that has been developed and applied in education
$IC2_{Inf}$	Collect information about initiatives and proposals for introducing AI in education
$IC3_{Inf}$	Collect information about the benefits of AI use in education

2.5 Summary of Results

This systematic review was helpful to expand the research on the AI application in education. The analysis of the studies identified is further detailed in the following sections.

3 Analysis of Selected Studies

Huiyan Li et al. [2] stated that AI can have a major influence on education and teaching and, without changing its essence, can provoke the transformation of teaching models and the learning effects. As mentioned in the article, AI can be used for:

- *Promote the development of teaching resources*. AI provides teachers with tools to visualize and self-develop their methodology and encourages them to constantly improve teaching resources, avoiding the waste of material and human resources.
- *Perform efficient and personalized learning*. The use of smart tools makes easier the search for information, a task that can often be complex due to a large amount of information, sometimes irrelevant, that can be found on the Internet. Therefore, AI can be used to improve knowledge selection efficiency and information retrieval. In addition, it can provide adaptive teaching according to the needs of each student regarding their learning habits and their level of knowledge.
- *Improving teaching quality and efficiency*. The virtual assistants can help teachers to improve their teaching method to add more value to students, and using image recognition technology they can develop tools to grade student projects and exams objectively and quickly.

Huiyan Li et al. [2] listed several ways to apply AI in the education field. These are:

- Intelligent Virtual Assistants and Chatbots,
- Intelligent Education Systems,
- Intelligent Exam Systems, and
- Virtual Reality.

The examples of applications of AI-based tools in the education field identified during the systematic review were grouped following the former classification in four categories, as the authors considered an appropriate approach. These four categories, and the AI-based tools used in education within each of them, are next presented.

3.1 Intelligent Virtual Assistants and Chatbots

Intelligent Virtual Assistants (IVA) and chatbots are software agents that can simulate and process human conversations, allowing users to interact with technology devices as if they were communicating with a real person. The main difference between the Intelligent Virtual Assistants and chatbots is that the first ones are intended to help users to perform some tasks, such as setting alarms, writing messages, or making calls. While chatbots are used by users to acquire information. These two types of software agents are commonly used in companies because of the efficiency they provide some services such as customer service. However, the environment for the use of IVA and chatbots can be very wide and can be adapted for use in education to support the teaching work of teachers, or to facilitate the learning and educational experience of students. This section describes some application cases of this type of technology in education.

Ho Thao Hien et al. [3] mentioned that chatbots can work as an optimal learning method by repeating lessons to students over a reasonable period so that students do not forget them. Chatbots can also be used to gather feedback on a course or subject, a very valuable source for improving learning and teaching. Such tools can also answer common questions on a particular topic, making learning support more comfortable and faster. For example, they can streamline administrative tasks such as delivering assignments or documents, viewing grades, exam schedules, and so on.

3.1.1 FIT-EBot

In [3] the authors explain the usual basic components that make up a chatbot and which are: Analysis of the message entered by the user and the Response generation. The Message Analysis component uses Natural Language Processing techniques to understand what users are talking about. This action is divided into two tasks:

- *Identify the user's intent*: To determine the purpose of the messages entered by users.
- *Extract the user's context*: To extract information related to the context in which the message was entered. This information may be related to user profile, time, device location from what the chatbot has been used for, etc. The aim is to use this information to know the user's situation and generate an appropriate response.

The Response generation component is built based on the question and the user context information. From the result obtained with the previous component. There are three models for developing appropriate responses: Pattern-based model, Retrieval-based model, and Generative model.

Pattern-based model is based on matching messages/questions entered by users, with a question-answer pattern already defined in the system itself; it responds to the user with a predefined response. The goal of the Retrieval-based model is to provide the best possible answer from a database of predefined answers. It uses techniques such as keywording matching, Machine Learning, and Deep Learning to identify the most appropriate answer among those available in the database. Regardless of the used technique, the Retrieval-based model only provides predefined answers and does not generate any new output. Compared to the Pattern-based model, the Retrieval-based model offers more flexibility.

For its part, the Generative model is the smartest of the three models, in terms of generating responses based on current user messages, and from previous messages. Generative models use a combination of Supervised Learning and Non-Supervised Learning to be able to create response messages. However, they still need to be trained with a very large data set to offer a good conversation with users.

The chatbot, FIT-EBot presented in the same article, is based on the Retrieval-based model. This chatbot can act as a teacher and administrative assistant to quickly answer students' common questions; especially related to exercises, scholarships, course schedules, etc. FIT-EBot has been implemented under the framework of Dialogflow, a Google tool that integrates Artificial Intelligence techniques to analyse user messages and generate responses.

During the User Intent Identification task, text messages entered by users are classified into 13 different categories. This allows the system to find the right answers quickly. The FIT-EBot chatbot supports questions such as: "What is the deadline for submitting the final project of the Introduction to Programming course?", or "Could you please tell me my grade for the Database course?". Questions that correspond to the categories of Exercises and Qualifications, respectively.

Once the user's intent has been determined, the user's context information is extracted. To do this, FIT-EBot uses a Named Entity Recognition (NER) system, which is essentially a model based on assigning a specific tag to a block of words contained in the message entered by the user, such as name, location, time, among others.

To generate response messages based on the question entered by the user, the chatbot returns two types of answers. On the one hand, if the system identifies that the message does not ask for information on a specific topic, it returns fixed and unalterable messages. For example, when the system determines that the entered message is a greeting, the chatbot returns "Hello, I'm FIT-EBot". Instead, when a student asks for their grades in a particular subject, the system queries the database, and based on the obtained result, it generates a response.

A significant advantage of chatbots is that they can detect if the information is missing to respond to users properly, and if so, the system requests additional information before generating the final response.

All the components that have been described, as well as the interaction between them, can be seen in Fig. 1, which reflects the combination of FIT-EBot components that are used to handle user messages. The FIT-EBot chatbot is a tool that supports teachers and administrative staff at the Faculty of Information Technology of the Ho Chi Minh City University of Science in Vietnam, as well as provides a better experience to students, as it facilitates tasks that may before they required more effort and dedication of students.

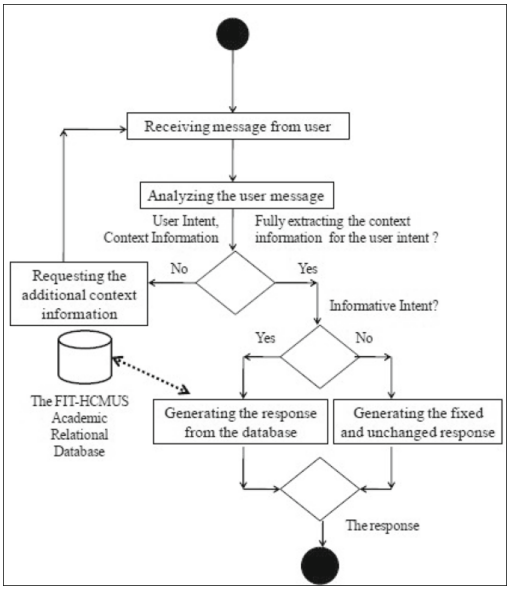

Fig. 1. FIT-EBot process

3.1.2 LenoBot

BINUS Online Learning is an information technology-based educational institution for distance learning programs in Indonesia [4]. As the study authors describe, distance learning has many advantages, as students can view the lessons and do activities without any time or place limitations. In addition, the teaching materials available to students are of high quality as they have been carefully prepared by teachers. However, not being able to ask teachers questions in real-time, as in the case of face-to-face sessions, is a disadvantage for students.

Professors at Bina Nusantara University proposed the development and implementation of an interactive support system in the learning process that, in real-time for 24 h a day, answers students' questions. The proposal is a chatbot that can be integrated with the university's Academic Management System, which can increase the retention rate of student content by 10% and can also increase the level of student satisfaction with the reduction of the response time and the high availability offered.

This tool was developed with the Natural Language Processing (NLP) approach so that students can interact with the chatbot in their native language. The LenoBot chat is connected to a database where the support material managed by the university departments is available. The system consists of two components: one for students, and one for teachers.

The student's component allows students to complete the following tasks:

- Students can view the LenoBot initial page, which explains what it is and how to use it.
- Students can start a text-based chat, introducing questions related to the subjects they are studying.
- Students can see all the questions that other students have submitted and that the chatbot has answered.

The teachers' component supports the execution of the following actions:

- Teachers can access the LenoBot page to manage learning materials.
- Teachers can manage support materials to add, change, and disable available materials in the database.
- Teachers can view the LenoBot dashboard with information about the tool's use for over a week, and can also download reports related to unanswered questions, frequently asked questions, etc.

3.1.3 InfoBot

Infobot [5] is another chatbot that was created in 2020 to be an online tutor for a college course. This tool provides students with almost the same features as LenoBot [4], described in the previous section. The main difference between the two chatbots is that Infobot offers students the chance to complete multiple-choice questionnaires, created by teachers, to test their knowledge, and at the same time, encourage their retention.

Infobot was implemented using DialogFlow, a Natural Language Processing platform that works with two components: an inference engine and a database. The inference engine can extract useful information from questions entered by students. As for the database, Firebase is used. Teachers can easily upload teaching materials to the database using a user interface or using a data file in JSON format.

Another feature offered by Infobot is that it can be used through different social networks, such as Telegram and Facebook Messenger. It also supports different input methods: natural language, commands, multiple options, and key terms. That last feature allows teachers to set up certain multiple-choice questionnaires. So, if the user enters the word "quiz", the chatbot will answer with a question based on a specific topic, and N buttons with possible answers will appear in the interface.

In addition, Infobot also offers other features which are mentioned below. Students can ask questions related to logistical information of a course: schedules, exam dates, delivery deadlines, how to contact teachers, etc. To request this information, students must have logged in to their academic accounts. Furthermore, like LenoBot [4] students can ask questions about the learning materials of the subjects they are taking. Teachers can import and manage the database through a chatbot, to add or modify teaching materials, grades, exams, etc.

3.1.4 Jill Watson

In 2016, the University of Georgia had a teaching assistant, Jill Watson [6]. This is an example of a virtual education assistant used in the Knowledge-Based Artificial Intelligence (KBAI) course. This assistant was available 24 h a day to answer questions posted by students in the course discussion forum. As mentioned in the article, the goal was to get Jill Watson able to generate an answer to the questions asked by the students. The use of Jill Watson in the KBAI course was so positive that it was improved and applied to other courses.

3.1.5 Scarlet

Scarlett is another virtual assistant [7]. This teaching assistant aims to help students in their learning process, ensuring a quick and efficient search for content in the documents or learning resources available to them. Scarlet is designed to work according to a questions and answers scheme so that students ask a question, and the system can answer it, although it could be adapted to different input schemes. This system consists of 3 different modules.

The first module is Natural Language Processing and implements methods to adapt response models to the input model. The second module is Pseudo-Analysis of Contextual Data which allows the same implementation to be used in different languages. This module uses the output of the previous module to browse all folders and subfolders on an FTP or local server recursively. Folders can contain files in "doc", "docx", or "pdf" format, which contain information for processing responses/outputs.

The third and final module is Trial and Error Learning, which asks students if the answer generated by Scarlet Assistant was good or bad. The system then assesses whether the received feedback is positive or negative. If positive, the module saves the input-output pattern used. The output of this last module is used in the first one to obtain a learning cycle.

3.1.6 ProblemPal

ProblemPal [8] is the name given to an Alexa feature that allows teachers to generate practice materials automatically through voice commands. This tool uses the Wikipedia, Wolfram Alpha, and Khan Academy APIs and can generate questions on any topic. Once the questions are generated, these are uploaded and shared with the students through the Google Classroom tool. As stated in the same article, ProblemPal can reduce the teacher's workload, and can also be a tool to add more value to students.

An example of Alexa's use in classrooms is that of Middletown schools, which since 2013 have been transforming their teaching method by incorporating technology and blended learning. The author of this transformation, Kenneth Eastwood, proposed the incorporation of several microphones in each classroom to recognize the students' voices, and interpret their questions and/or comments. In this way, a Connected-Learning application could provide answers to students through their personal computers. Thus, students could work with headphones to have a more individualized and quiet experience in a shared classroom environment. According to the author of this proposal, these devices could also send real-time data to teachers for information on where and how

to help students. Eastwood points out that the purpose of these devices is not to be a substitute for teachers, but to offer a tool to prevent students from getting stuck in some concept causing their learning to fail, while providing teachers with a lot of information about the student's needs.

Similarly, a new project was implemented at the University of Idaho (UI) during the 2017–2018 academic year also to research how can affect the integration of Artificial Intelligent in education. To develop the project, 90 Amazon Echo Dot devices were distributed to four Idaho educational districts so that teachers and students could use them during classes. According to the article, teachers used it especially to schedule reminders and timers; while students often used it to request information by voice.

3.1.7 KEMTbot

Chatbots can also replace teachers in some ways as does the tool presented by Stanislav Ondáš et al. [9]. The article mentions that the Database students at the University of Kosice are often demotivated due to the high volume of teaching material they have at their disposal and that they need to consult to carry out the tasks assigned to them by teachers. Teachers often suggested that students watch a set of tutorials with explanations and examples so that they could do the exercises as assigned to them.

The chatbot authors realized that the workload and the difficulty of watching the tutorials and doing the exercises were very high, and they thought that they could try to increase students' motivation by providing them with knowledge and tasks sequentially, or that students could adapt their learning process. Thus, the teachers of the subject "Databases" decided to use a chatbot to reduce the cognitive load of students. This tool allows students to easily search for certain concepts, interrupt the learning process, skip lessons, etc. This chatbot was created using the Dialogflow platform, and the Heroku platform was used to store the data used by the chatbot.

3.1.8 Chatbot to Help Students

Chatbots can also help students with issues related to university life. This is the case of Beacon, created at the University of Staffordshire [10]. In 2019 they made a chatbot available to students to offer them help all day. This AI-based tool can provide personalized information about students' schedules, allows the students to contact teachers, and is also able to answer 400 questions related to the campus facilities and services offered there. Beacon also aims to meet the needs of students to be able to serve them in the best way, and to offer them the best university experience.

At Deakin University in Australia, a chatbot was also implemented, in this case, based on IBM Watson [11]. This chatbot was able to answer questions about the university campus. During the first 12 months of its implementation, Watson answered more than 55,000 questions, and Deakin University improved it to expand its capabilities and teach it to be able to consult new information sources to answer other types of questions to students.

3.1.9 NEEV

In India, the development of the NEEV system [12] was proposed in 2019, an intelligent chatbot that uses Supervised Machine Learning and Natural Language Processing techniques. The goal of this tool is to reduce the workforce needed to answer user questions, a task that is expected to be done by the chatbot by providing users with intelligent communication. Unlike other chatbots described during this article, NEEV accepts questions and answers them both by voice and text. With the use of Artificial Intelligence techniques, the chatbot can give appropriate answers to the users and allows the user to establish a comfortable communication like this one as it is not necessary to follow any standard format to make any query.

The NEEV chatbot system, implemented as an Android application, uses Machine Learning, Natural Language Processing, and Natural Language Understanding (NLU) techniques to process and understand user requests. Thus, when the user requests the system, the answer is obtained in text or voice format. If the format is voice, the input is converted to text. The request is then processed, and an appropriate response is searched or generated. This system is expected to reduce the students' workload when performing administrative tasks or queries, providing them with quick and accurate answers.

There are other tools, not directly related to learning or helping students, that use Artificial Intelligence to provide feedback to teachers. In this case, the use of Machine Learning and Natural Processing Techniques is suggested. A general example might be the implementation of a chatbot to gather the students' opinions on the teaching work, with the ability to adapt each conversation with students according to their personality.

3.2 Intelligent Education Systems, Intelligent Exam Systems, and Virtual Reality

The use of AI in education can also be used to provide students with Adaptive Learning (AL). ***Intelligent Education Systems*** aims to use AI to implement and offer personalized instruction, to give knowledge, and provide guidance to students with different needs and characteristics. Currently, these systems cannot compete with traditional learning systems, although they seek to optimize their efficiency. This is the case with the Adaptive Learning System Yixue [13]. This Computer-Based Learning environment can adapt content and guide students. The system offers the following functions:

- Create a fine-grained knowledge map where knowledge components are organized hierarchically based on a relationship of learning progression.
- Diagnostic pre-assessment.
- Adaptive and automated instruction.
- Gathering immediate feedback and detailed explanations by students.
- Rich and high-quality learning repository with various types of learning content.
- Teacher support and intervention in class.

An example might be SuperMemo [14], a tool developed in the 80's tracking pieces of information that users (students) learned, and want to remember. SuperMemo is based on the forgetting curve and reminds the user who should practice-specific knowledge when the probability to remember this information has been reduced to 90%. This action

reduces the forgetting rate. To determine when it is necessary to suggest to the users to review the knowledge or to practice some exercises, the tool tracks the likelihood of remembering information, to reduce the frequency of knowledge review. Although SuperMemo is an old tool, its essence has been maintained over the years and there are similar applications focused mainly on language learning. This is the case of Memrise [15], a free and smart application to learn languages; or RemNote [16] a note-taking tool that allows the user to remember and organize what has been learned, as it has a repeating system that helps to consolidate knowledge in long-term memory.

The ***Intelligent Exam Systems*** are software systems that use AI to improve the efficiency and effectiveness of the automatic assessment. These tools aim to simulate the behaviour of teachers in correcting and grading students' exams and projects. A remarkable feature of these systems is the ability to represent knowledge through symbols and symbolic operations. Thus, for a specific question, teachers can predefine the correct or desired answer that the system interprets as symbols. In this way, the system can determine the degree of correctness of the answers entered by students. Other Intelligent Exam Systems have also the ability to generate adaptative exams, from question banks, or by accessing the Internet. An example would be the system proposed by Huiyan Li [2], based on the use of a system to encode the exam questions, the expected answers, and the student's answers to determine the correctness of these. Copyleaks AI Grader [17] is another example of AI-based grader. This tool can automatically and accurately qualify large volumes of tasks, as well as calculate the grade for the assignment. For the tool to be able to qualify for the projects and exams, an algorithm training process is required. For this reason, teachers must provide the system with a set of corrected and graded example tests. In this way, the tool will learn the aspects that are relevant to correct the exams and practices, to be able to evaluate the rest of the tests efficiently and accurately.

Virtual Reality can also be used to create an interactive for students to learn autonomously, performing the active construction of knowledge. Virtual Reality technology can be applied to teaching in different ways [18–20]. The first one is the Virtual Classroom, a space that represents students and teachers as virtual objects, achieving a total immersion in a simulated classroom. Secondly, it can be applied to simulate a virtual lab that partially replaces experiments that are difficult to reproduce in the real world. Thirdly, Virtual Reality technology can be used to simulate a Virtual Campus, and visualize the university campus life to make students aware of the academic offers and services available to them.

4 Discussion and Conclusion

From the research and further analysis of the studies identified, it can be concluded that research on the application of Artificial Intelligence in education is extensive. The research undertaken made it possible to acquire knowledge about AI-based tools used for education purposes.

There are different ways to apply AI in education. Most of the implementations detected are related to chatbots or Smart Virtual Assistants. Most educational chatbot implementations present the chatbot as a tool that can support students in their

days at school. They aid students to carry out administrative procedures; the search for information related to the modules they are studying; the search for information of an administrative nature; and conducting activities or tests to assess the acquired knowledge.

Throughout this article, many benefits that chatbots bring to users who use them have been listed. These benefits include high availability, consistent responses, and the learning ability that some of them have to offer better real-world interaction with users.

Being so easy to use makes it a great way to get students' attention. For example, to motivate students to ask questions or to request a tutorial, as well as to speed up the process of finding and selecting useful information to solve students' doubts. In addition, it could prevent students from being "blocked" without being able to advance in the study or the final project realization because they are waiting for the answer of the professors of a subject. Moreover, it seems that the chatbots' ability to learn and adapt can benefit students of any academic level and students with certain special needs, improving the care they receive and facilitating the performance of student tasks.

Artificial Intelligence could also benefit students and teachers with the use of Intelligent Testing Systems, Virtual Reality, or Intelligent Learning Systems. However, few implementations of this kind were found during the research. It should be noted that most of the described applications were still in the testing process, and some were in the process of being implemented. Therefore, no significant data on the success of these tools is available. It is clear from our research that interest in AI for education is significant, and that AI holds substantial promise in terms of the learning experience and outcomes for participants. This is a field that has been evolving for some years, but which certainly can go much further in terms of integration into education settings, for which we advocate for a more thorough academic evaluation of purported benefits and limitations.

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