**Artificial Intelligence in Education**

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***Abstract—* This paper was performed in the educational sector under the domain of Artificial Intelligence. A way back, the process of assigning human intellect to computers was given the term artificial intelligence, which has made tremendous progress in the rapid expansion of the modern world. Hence the concept of combining artificial intelligence with education arose, leading us into the twenty-first century. However, the current study indicates that artificial intelligence research is having a favorable impact on educational methods. This paper provides an overview of several strategies for implementing AI-based technologies in the education sector. With the help of these tools, AI has made education more fascinating and simple for teachers and learners alike. Ai has bestowed upon us a ready-made learning environment that includes a variety of expert system applications, collaborative robotics, smart AI assistants as well as a smart learning environment. Moreover, numerous proposed models for this topic are mentioned in this research, which has promising potential in the near future. Therefore, this review paper will lead us to a conclusion that the future of Ai in the educational sector seems to be quite promising.**

***Keyword*:** artificial intelligence, cobot, smart learning, AIED

**I. INTRODUCTION**

What if a student has an associate in his studies without any allegation of plagiarism! Thanks to advanced artificial intelligence technology, this is possible in modern times. This technology is called an intelligent/Smart assistant. Intelligent/Smart assistants are pre-programmed machines that work at the level of machine learning and behave like ordinary personal assistants. We have these smart assistants on our mobile phones, laptops, and other devices. Today, technology is becoming more and more intelligent. In recent years, artificial intelligence has improved significantly. Research shows that artificial intelligence will be integrated into our education system at all levels in the upcoming future. In the future, it is possible that Ai will be the teaching assistant of the day.

Artificial intelligence refers to the modeling of human intelligence processes using machines, especially computer-aided assistance. These processes include learning, thinking, and self-correcting. The term "artificial intelligence" was proposed by John McCarthy in 1955, who made a proposal at the famous Dartmouth Conference in 1956 [3]. Although Alan Turing proposed an intelligent reasoning model in 1937, this model formed the basis of computer science [9]. Later, in 1950, Turing extended his concept in the article "Computer and Intelligence", which was regarded as the basis of artificial intelligence [9]. Since artificial intelligence is a broad interdisciplinary subject, it can be integrated into many scientific fields, including computer science, physiology, philosophy, psychology, and mathematics [1]. Its purpose is to create intelligent applications at the machine level and hope to realize artificial intelligence at the human level [1]. The idea of creating artificial intelligence is not new [9]. Artificial intelligence is advancing rapidly. The most recent example of AI at the superhuman level was when machine learning-based AlphaGo defeated Korean Go grandmaster Lee Sedol (Zhang 2016). The technologies associated with AI are being integrated into every part of our daily lives. From product recommendations on ecommerce sites (Alibaba, Amazon etc.) to smart assistants (Google assistant, Siri, Alexa etc.) and other virtual assistants, AI assists us in various regular tasks. Self-driving cars is one of the hot topics using this technology which has become so much popular in a short amount of time.

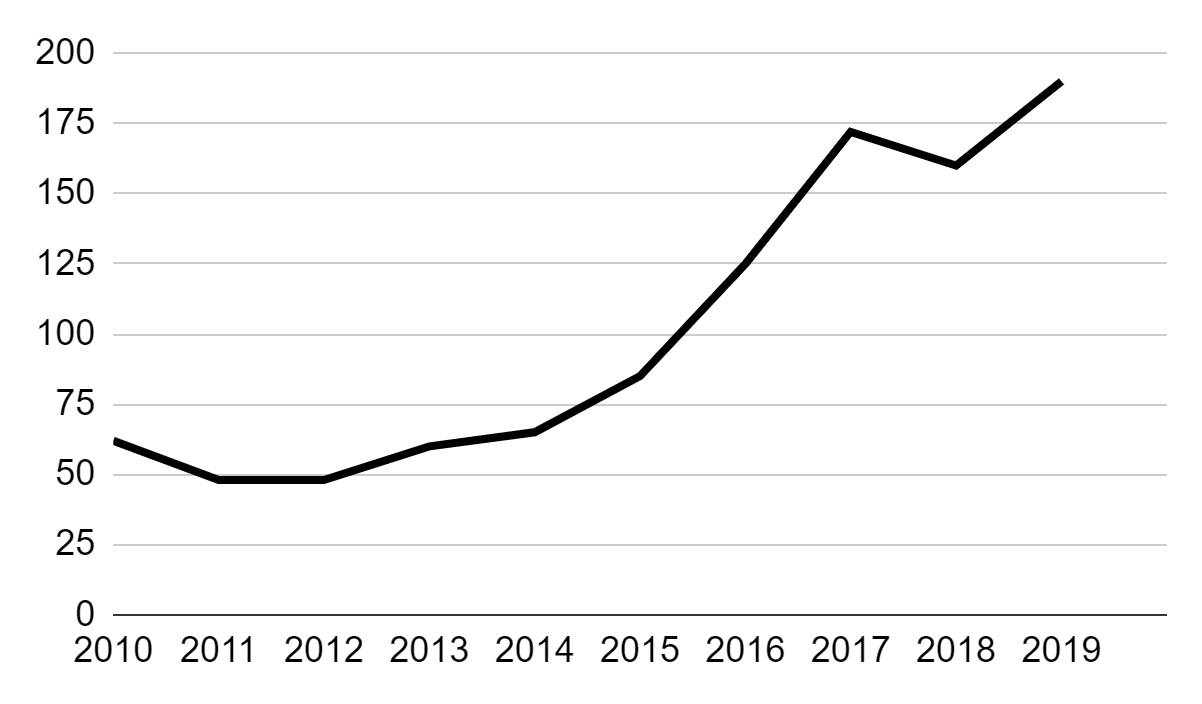
Artificial intelligence application in Educational purposes is much younger. However, there is a growing interest in using AI algorithms and systems in education. Since 2010, the number of papers published in various scientific journals on 'artificial intelligence' and 'education' has been increasing. Papers published between 2015 and 2019 accounted for 70% of all previous papers in this field published in the previous ten years [4]. The technologies made with artificial intelligence for the purpose of education does not look like a robot or a variety of devices, it takes a virtual form. It may involve physical elements such as the Internet of Things audio or visual sensor (IoT) that collects or monitors environmental information. It is exposed through smart software processing systems. These software has a wealth of functions, including intelligent content development, personalized learning experience, education extension, education management simplification, intelligent learning and learning.

This research article provides a brief overview of modern artificial intelligence technologies that make our learning experience enjoyable and introduce us to revolutionary changes in the education system. This article also shows how artificial intelligence can help students minimize difficulties and how it can improve the design of new educational experiences. Secondly, students are going to understand the concept of the "modern classroom" [7].This research can explain the interaction between students and teachers through humanoid robots. From the perspective of students and teachers, this is more acceptable. Furthermore, this research work emphasizes the existing performance of artificial intelligence in academic learning as well as the future contribution of this extraordinary technology.

**II. SEVERAL RESEARCH METHODOLOGY**

This part of the research will consist of the basic description of various methods used in the articles. In essence, we are presented with the elementary description of the various types of charming educational programs that artificial intelligence offers us. In recent years, researchers have made efforts to further develop the education system with the help of the implementation of various artificial intelligence methods.

Here is a bar chart based on the number of papers on AI in Education that have been published in Web of Science and Google Scholar over the last ten years:



**Figure: Line Chart of AI in Education based on papers**

***A. The expert system application in education:***

The expert system is an intelligent computer software system with extensive knowledge and experience in a certain field like a software system, it is characterized by being able to draw conclusions and prejudices based on past events, experiences, and to adequately disclose the results of the argumentation [1][2]. Domain experts or knowledge engineers implement knowledge acquisition in expert systems using specialized software tools or programming, and they constantly enrich and perfect knowledge in knowledge bases [1].

The artificial neural network is also connected to the expert system with a view to improving the operational competence of the expert system for education [1]. Intelligent Computer-Assisted Instruction (CAI) System uses artificial intelligence technology to simulate the performance of the human learning process in the form of a computer. There are several development languages such as NATAL, PILOT to assist teachers in designing such a CAI system but those have also boundaries [2]. The CAI system should be able to analyze a wide range of student responses; this usually requires the participation of experts in the subject, that is, the ICAI system is a subject-specific expert who is a professor or mentor. In recent studies, it has been found that AI specialists have focused on expert or ICAI systems. One of the earliest ICAI systems was called **SCHOLAR**, and it was designed to learn facts about the geography of South America. Instead of storing geographic information in pre-made forms, the plan is organized around relevant knowledge, including simple geographic information about industry, exports, population, and capital cities. SCHOLAR was designed to generate real-world questions, evaluate student answers, and manage student questions based on student knowledge.

**SOPHIE**, another ICAI system which is used for troubleshooting. SOPHIE is not to teach users electronic products, but to provide students with a learning environment where they can develop problem-solving skills by testing ideas. SOPHIE is a computer expert who helps students develop, test, and debug appropriate hypotheses [2].

**ROSS Intelligence** called an expert system withinside the study [15], is a part of a software program that runs through Natural Language Processing (NLP) and a proprietary system Legal Cortex combined with IBM Watson’s cognitive computing technology. This expert system is capable of dealing with full sentences given by a user and based on that question Ross Intelligence performs legal research on the web based on understanding of that particular question. This expert system is capable of dealing with complete sentences given by a user and based on that question Ross Intelligence conducts web-based legal research based on the understanding of that particular question. The Ross Intelligence System, in instance, will generate some notes based on the research it has conducted, and it will automatically send the draft through email if the user selects that option when instructing the system. A user can provide feedback to the system at any time so that it can improve its working methods and provide satisfactory results to the user [15]. The goal was to develop it as an AI lawyer. Furthermore, ROSS manufacturers have included a "Law Monitor Button'' that allows ROSS to examine the most recent laws relevant to investigations [16]. According to the findings, the ROSS intelligence system could only be utilized for bankruptcies, proprietary information, and employment law research till now [15]. It can also be used in the education sector to help students undertake research.

***B. Cobots in AIED:***

Robots are an important part of artificial intelligence systems. With the emergence of student-centered learning robots, innovations in systems and learning models have been realized-assisted test learning, teacher-student robot-agent interaction, application scenarios. In the past 25 years, robotics has made significant progress in the education system. Robots are now doing homework, various kinds of work related to classroom study, which is beneficial for the students. The best part about it are the robots as they are multitasking [7].Learning robots experience abstract concepts such as touching objects. The concept of the object, which teaches the instantiation of the object, is the process of existence of its exact meaning with understanding the proper use of new keywords. This process instructs students to become aware of the characteristics of object-oriented programming (OOP).

Collaborative robots (Cobot) are companion robots that work with people to help them get their jobs done. One of the examples of Cobot is Universal Robots which is a robotic arm that is being used in both industries and in the education sector. From. According to another research [12] we found a similar robot called Pomelo which is an interactive robot. Its goal is to teach coding to younger children in an easy-to-understand manner. Basically, Pomelo uses games to educate students basic algorithmic abilities with improvement of teamwork. It has the appearance of a friendly dog with a screen that shows its eyes and communicates with the kids through auditory and sight. Pomelo's personalized response capability is being enhanced through face and emotion detection as well as the incorporation of a learning mechanism applicable to perceptual information. Moreover, Pomelo employs a number of components, including a RasPi camera, the OpenCV ArUco library, an LCD screen, a Voice HAT Board, a microphone, a speaker, and the Google Assistant API.

Therefore, the educational collaborative robot is a robot designed to assist human teachers. Using educational cobots in the classroom would help the teacher differentiate the lesson so that students receive a more personalized lesson. In order to achieve this vision, it will be necessary to complete the work already done in AIED order to achieve this vision. For example, if educational collaborative robots have AIED skills, they can observe the learner's interaction with the intelligent learning environment, identify and help learners who need additional learning support, and maintain learners' participation and interest. And answer any questions that students may ask [7].

***C. Smart Learning Environments:***

Smart learning environment reflects academic articles on the account of reforming our teaching and learning methods by evolving today's learning environment into an intelligent learning environment. Learning environment needs to be human-centered where learning and interpersonal interaction are connected. Consequently, the intelligent learning environment should focus on performance as well as human feelings and results should be the main focus [6]. STATPLAY is a computer based smart learning environment mentioned in the research article [5]. It includes tools, interactive simulations and games to help students understand some basic statistical concepts. An effective way for teachers to use STATPLAY is to record all interaction sequences at the same time, including voice comments. The entry is saved under a name, and future users can call it by selecting it from the menu. Both teachers and students can record their demonstrations and submit questions or problems. in this way it becomes a powerful and flexible construction tool [5]. In addition to AI's numerous platforms and applications, smart interactive learning environments are utilized to monitor performance and provide feedback and exchange of ideas between teachers and students. Intelligent tutoring systems such as ACTIVEMath [11], MATHia, Why2Atlas, Comet, and Viper, as well as substantial use of learning evaluation to evaluate performance and enhance accessible learning resources, have been employed by different levels of education or trainers at different levels of education [10].

**SOFT COMPUTING-BASED SYSTEM** is a proposed AI based smart learning environment. The proposed system's major goal is to use AI-based technology to process the user's inputs. The data processing tool based on AI receives data input, turns them to datasets and transfers them to the report management module. The smart learning system receives input on all of the queries and sources that were processed. This model enhances overall intelligibility precision. In addition, the AI-based report management module receives, analyses, conducts and triggers the action by classifying the user entry using the free text technique. All of the analyzed sources have been saved and modified in the learning database. This module includes a variety of features, including learning-based information storage and a data processing tool. The smart classroom is mostly utilized for university course training and is a place where students can learn theoretical information and motions. The design of a smart classroom is divided into two sections: spatial design and technical design. The space is methodically planned, teaching facilities are evenly distributed, and the characteristics of complex aspects are achieved to the greatest extent possible to give learners a developing learning environment [14] and this Soft Computing-Based System is one concept for implementing smart classrooms.

***D. Smart AI Assistants in Education:***

A personal assistant is a kind of software by which spoken or written commands are recognized and carry out the client's requirements. To give services to consumers, voice assistants rely on technologies such as voice recognition, speech synthesis, and Natural Language Processing (NLP). The majority of smart speakers lack a screen though some do, such as the Amazon Echo Show, Echo Spot, the Google Home Hub and the Facebook Portal. Some of the most popular AI assistants are Alexa, Siri, Scarlet, Amazon echo etc. The bulk of smart assistants employ NLP as a technology. These assistants employ natural language processing (NLP) to evaluate text-based speech and comprehend the user's needs. Following the recognition of the intent, the needed action is carried out via the underlying API connections, with feedback returned to the user. Text To Speech (TTS) engines are used for spoken language conversion, whereas Speech To Text (STT) engines are used for text conversion. In voice assistants, the Graphical User Interface (GUI) is being replaced by conversational user interfaces (CUI) or voice user interfaces (VUI), and Natural Language Processing (NLP) requires the program to be far more adaptable to context changes than traditional graphical interfaces [13].

When a voice assistant, such as Siri, Alexa, or Google Assistant, hears its trigger phrase, it starts recording. When someone completes his request, the assistant waits for a pause to know. The voice assistant then uses the Internet to submit his recorded request to the database. The user request is compared to other requests once it has been saved in the database. It is separated into discrete commands that the user's voice assistant can understand. The device may ask questions to ensure that it knows what users want and is capable of carrying out the task.

| **Group** | **Ref. paper** | **Model/ Environment/ System** | **Type** | **key features** | **Framework/ API/ Components/ Methods** |
| --- | --- | --- | --- | --- | --- |
| Expert system application | [2] | SOPHIE | Instructional Environment Model | Electronic troubleshooting, develop problem-solving skills, debug appropriate hypotheses | - |
| [2] | SCHOLAR | ICAI system | Produce factual inquiries, examine the student's responses, learn facts about geography | - |
| [15] [16] | ROSS Intelligence | Software Program | Bankruptcies, proprietary information, and employment law research, performs legal research on web-based data | NLP, Legal Cortex, IBM Watson’s cognitive computing technology |
| Cobots | [12] | Pomelo | Interactive Robot | Develops algorithmic skills, collaboration through games, inspire to learn new technologies | Raspberry Pi 3, LCD Screen, Google Assistant API, |
| [17] | Universal Robots | Robotic Arm | Solve real world problems, Learning with programming, simulated learning | Polyscope graphical user interface, LCD Screen |
| Smart Learning Environments | [5] | STATPLAY | Computer based learning tool | Learn statistical practice in psychology, multimedia environment for introductory statistics, | Visual C++, comprised  playgrounds based on Windows 95, |
| [14] | SOFT COMPUTING-BASED SYSTEM | Proposed AI based smart learning | learning-based information storage,data processing | Face Recognition System (HD camera), Programming Language (Python), Database (MySQL), Server (Apache Tomcat), OS Windows 7 |
| Smart AI Assistants in Education | [13] | Google Assistant, Alexa, Scarlet, Amazon eco, Siri | Voice Application/Speech recognition device | Voice controlled environment, Personal Assistant, Searching information online, Feedback based on results | NLP, Neural network, Machine Learning Algorithms |

TABLE: COMPARATIVE TABLE BASED on SEVERAL AI SYSTEMS

**III. COMPARATIVE STUDY BETWEEN TOOLS/ MODELS**

Now-a-days, methods on AI based means to efficiently construct as well as usable knowledge in such a way that it is perceivable by the individuals who offer it. Moreover, it should be simple to change in the event of an error even though it is incomplete or erroneous. It should be beneficial in a variety of scenarios. We have discussed many types of artificial intelligence (AI) methods and techniques in education in the methodology chart. Now we’ll compare all of the strategies listed above and see how they’ll operate in the education industry in future.

If we concentrate on expert systems, two expert system applications that are widely employed in the education industry around the world are SOPHIE and SCHOLAR. SOPHIE was one of the first ICAI systems to support imperative interactions that were both engaging and educationally feasible. As it is the earliest one so the usage and popularity of it have dwindled. ROSS is an artificially intelligent lawyer, which is a legal expert system that uses artificial intelligence (AI) to replicate and improve on the capabilities of a human legal research assistant. It's a great gesture for those who can't afford a lawyer. Moreover, Ross is already being utilized by the legal firm Baker & Hostetler to handle their bankruptcy practice, which now comprises approximately 50 professionals. Though ROSS is not widely used due to lawyers' job insecurity, its initial cost is over $69/user/month. Without any doubt, this artificial intelligence (AI) system has a bright future.

Pomelo, one of the most well-known educational cobots, is a primary school-appropriate teaching robot whose objective is to teach coding to younger children in a simple manner. It is gaining popularity and making learning more enjoyable for young children. Universal Robot, on the other hand, is a high-priced robotic arm that costs more than US $23,000.These arms are in high demand in both the educational and industrial sectors.

StatPlay is a multimedia tool for conceptual understanding in any introductory statistics course. StatPlay has been well received by students and teachers, and the original version was used by approximately 3500 students across 12 departments at The University of Melbourne in 1997.

A proposed approach for a smart learning environment is the soft computing-based System. It is becoming more popular by the day. Basically, this information management module and document management tool were obtained by combining two components of an AI and NN-based system. Soft computing is utilized in everyday life in applications such as handwriting recognition, image processing, voice and vision recognition systems, data compression, manufacturing systems, machine learning applications, and so on.

Among smart AI assistants Google Assistant, Alexa, Scarlet, Amazon eco, Siri are very popular all over the world. From Canalys’s analysis it came to know, the installed base of smart speakers will reach 225 million by 2020 and 320 million by 2022. Moreover, Juniper Research declares Google Home devices and Amazon Echo are expected to be in more than half of US households by 2022, and global ad spending on voice assistants will reach $19 billion by the same year. In 2018, Apple stated that Siri was installed on 500 million devices around the world. With more than 70% of all intelligent voice assistant-enabled devices other than phones running on the Alexa platform, it is the clear translucent leader [13].

Our previously stated techniques are quite beneficial in a wide range of sectors. They are nevertheless linked to the education file in some way. We will see a huge improvement if we can make those approaches applicable in the education sector as well. Students will be able to build additional AI-based innovative technologies based on their gained skills as they learn more about AI. One additional reminder, AI will not be likely to substitute teachers. AI will relieve instructors of administrative duties, provide views into student growth and concentrate on what they do best allowing learners to flourish. Because of AI, learners can pursue their targeted educational goals without thinking about time and space constraints. Because numerous types of educational tools have broken down the barriers and assisted in the development of their skills. So, applause for artificial intelligence and its application in education. The world expects to witness more charismatic and enthralling innovations in education using artificial intelligence.

**IV. CONCLUSION**

In this review paper we attempted to demonstrate the application of artificial intelligence in the educational sector. On account of this, we compiled some review papers and evaluated various educational methodologies leveraging artificial intelligence (AI). The primary goal of this study was to determine whether or not those strategies are beneficial in our educational system. Almost eight review papers have been revealed to have some amazing outcomes; these papers contain extraordinary features that are somehow related to educational development. Researchers are increasingly interested in using artificial intelligence in education to achieve a desirable output. Collaboration with AI will revolutionize traditional education into one that is digitalized, which will benefit both educators and learners.

However, it is not easy; various obstacles remain in the effective implementation of education. Not only experts and developers, but also members of the general public involved in the education sector, should be convinced of the importance of AI in education. This could lead to more progress and implementation in the education sector.

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