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INTELLIGENT EDUCATIONAL ROBOTS: NEW HORIZONS TOWARDS THE PERSONALIZED LEARNING ENVIRONMENTS

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Abstract. *Technological developments have radically changed how individuals, communities, and surroundings interact. The mobilization of digital technologies, such as robots, to aid the Sustainable Development Goals (SDGs) of new technology has caused a significant evolution in teaching and learning approaches. Because AI technology has developed so quickly in recent years, its applicability in educational settings is becoming more and more evident. A few uses of educational AI include intelligent tutoring robots, smart campuses, teacher assessment, adaptive learning, and virtual classrooms. The objectives of this article were: to determine the role of intelligent educational robots in creating problem-based personalized learning environments in education and to determine how intelligent educational robots can be used as learning tools. To achieve the intended objectives of the study, a review of the literature was searched on different databases by using the inclusion and exclusion criteria. The results of the study were stated by evaluating the articles finalized for this study.*

Keywords: *Educational, Intelligent, Learning Environments, Personalized, Robots.*

1. INTRODUCTION

The curriculum must take into account the inventive change of the contemporary technical environment and the updating of technological activities in society. The goal of education should be to instill in students the information, skills, and abilities necessary to effectively preserve and advance society's scientific and technological potential as well as to successfully integrate them into today's socio-technical systems. In this sense, sections on technological innovation should be included in the curriculum of polytechnic education. In this regard, robotics is one (Pei & Nie, 2018).

Artificial intelligence (AI) approaches have witnessed significant advancements recently, drawing significant contributions from both academia and industry. Robustly increasing computer power and data availability are driving the growth of deep neural network-based machine-learning techniques, which are being used to enable increasingly intelligent robots (Chen et al., 2023). Robots are gradually being incorporated into daily life. Since social robots may be used to advance a kid or adolescent's intellectual growth, they have become even more significant in their lives (Huang, 2021).

The main goals of education are to comprehend and facilitate teaching and learning. Since communication, course design, curriculum architecture, assessment, and motivation affect both teaching and learning, it focuses on these aspects of education. The constant introduction of new technology and the quick development of AI approaches can enhance and improve teaching strategies (Yang et al., 2020). Artificial intelligence approaches have the potential to improve learning environments as well as how information is acquired, manipulated, and utilized. As a result, they may support teachers in enhancing their efficient instruction and encouraging pupils' unique learning. Consequently, it is critical to comprehend what and how AI approaches might be applied to meet educational objectives that result in easily accessible, reasonably priced,

productive, and successful instruction. Robots have been investigated and have grown in favour of the educational field with the use of AI technology (Chu et al., 2022).

In recent years, advancements in educational technology has improved the teaching learning process. Now the teachers are being replaced by intelligent educational robots for instructions in and outside the classroom. These advanced educational technology tools have made the teaching learning process very different from the traditional teaching learning process. Though the teaching learning process has become very complex by using advanced technological tools like intelligent educational robots, these tools may also provide problem based personalized learning environments according to the mental abilities of the learners. So, there is a need to explore how intelligent educational robots provide problem based personalized learning environments for learners.

Objective of the study

1. To determine the role of Intelligent Educational Robots (IER) in creating problem based personalized learning environments in education,
2. To determine that how Intelligent Educational Robots (IER) can be used as learning tools.

Research Question

1. What is the role of Intelligent Educational Robots (IER) in creating problem based personalized learning environments in education?
2. How the Intelligent Educational Robots (IER) can be used as a learning tool?

2. RESEARCH METHODS

The research methodology used for this study was based on searching the literature by different databases by using the inclusion and exclusion criteria. The keywords for searching the literature were: Intelligent Educational Robots (IER) and Personalized learning environments.

Identification

The Scopus, Web of Science, and ERIC databases were searched to find the literature on Intelligent educational robots. The key words entered in these databases were: Intelligent Educational Robots, Personalized Learning Environments. Initially, 143 published studies, including 61 from Scopus, 49 from Web of Science, and 33 from ERIC, were found.

Screening

After removing the duplicate 32 studies, the remaining studies were 111. The inclusion criteria were set to find studies closely related to intelligent educational robots and personalized learning environments. By setting the inclusion criteria, studies excluded based on abstract reviews were 48, not relevant to the keywords were 32, and not in English were 9.

Eligibility

After excluding the studies by setting the inclusion criteria, 22 studies were found to be eligible for the study. The exclusion criteria were also set for the final selection of the articles. The exclusion criteria were to exclude the studies that have no full-text access and have no link between intelligent educational robots and personalized learning environments. So, by setting the exclusion criteria, 11 studies were excluded.

Included

Finally, 11 studies were included and finalized for the study.

3. RESULTS AND DISCUSSION

The first objective of the study was to determine the role of intelligent educational robots in creating problem based personalized learning environments in education, and the research question regarding this objective was what is the role of Intelligent Educational Robots (IER) in creating problem based personalized learning environments in education? The researchers tried to achieve the intended objective and to find the answer to the research questions as follows:

A systematic approach to learning design known as "personalized learning" adjusts instruction to each learner's unique requirements, preferences, strengths, and objectives. It guarantees a broad selection of new subjects and skill development, which results in a full learning experience. With individualized learning, educators are given the responsibility of empowering students to take charge of their education by helping them create and carry out learning objectives that are tailored to their individual needs and interests. Students' academic performance is improved and learning is motivated by individualized learning methods and methodologies (Zlatarov et al., 2021).

The value of the learning environment and individual development is emphasized by personalised learning. Many services, educational resources, and apps that are customized to meet the needs of each student are included in a personalized learning environment. Web 2.0 and Web 3.0 technologies are employed to provide more affordable training, improve user experience, and generate customized student profiles. Adaptive systems may be tailored to meet the needs of individual students, emphasizing certain subjects and repeating lessons that are not fully understood (Klašnja-Milićević & Ivanović, 2021).

Personalized learning experiences are among the most interesting possible applications of robots in education. Robots may adapt their interactions and material to each student's learning style and skill level by utilizing AI and data analytics. By using a customized approach, every student may reach their greatest potential, and learning efficiency is maximized. Robots that help students learn languages and provide them with conversational practice according to their proficiency level are two examples of current implementations.

Students from various age groups, academic backgrounds, and socioeconomic backgrounds can improve their academic results and learning experiences by utilizing artificial intelligence. Technologies based on artificial intelligence are essential to the creation of customized learning paths. AI enables the employment of various teaching strategies that benefit every student, taking into consideration their learning style, aptitudes, shortcomings, and academic issues. Social and emotional learning abilities may be developed using advanced analytics and machine learning. Teachers can create individualized learning routes and analyze qualitative and quantitative data thanks to new technology. Using an immersive virtual environment, instructors may provide instructional programs to students with the use of artificial intelligence, data, analytics, and machine learning. This strategy aids in guaranteeing the caliber of remote education and efficient instruction (Duggan & Knyazeva, 2020).

As the teacher's "teaching assistant," the robot helps the instructor impart information and teach curriculum. When educational robots are used in the classroom, knowledge may be given in a more three-dimensional and natural fashion, which tends to be more engaging for students.

Construction of Teaching Environment

A "guidance-feedback" relationship develops between the instructor and the students in a classroom assisted by an intelligent educational robot, as well as between the robot and the students. The robot reacts to the teacher's request for an application and gives comments on the student's performance at the beginning of the lesson. Teachers may instruct the robot, for instance, to monitor their pupils' emotional states and learning progress in real-time. After processing and analyzing the data in light of

student input, the robot gives the teacher the results. Textbooks and other digital teaching resources are not the only source of teaching content in a digital classroom; teaching media also includes a digital environment made up of hardware and software. It also incorporates extensive Internet resources, music and video files, and other multimedia content. Together with the educational robot's cooperation with the digital world, the instructor and the robot carry out teaching and learning duties (Ran, 2023).

Intelligent Educational Robots (IER) as a Learning Tool

The second objective of this study was to determine how intelligent educational robots can be used as a learning tool and the research question for this objective was how the Intelligent Educational Robots (IER) can be used as a learning tool. The researchers tried to achieve this intended objective and to find the answer to the research question as follows:

It is acknowledged that robots are cutting-edge teaching tools. Numerous studies have suggested that this new method might alter the way that education is currently delivered and help students learn in a variety of settings. According to Evripidou et al. (2020) educational robots can improve a range of student abilities, including computational thinking, problem-solving, creativity, self-efficacy, and cooperation. Furthermore, robots have been used in several academic fields, including science and mathematics, languages, and multidisciplinary STEAM (Xia & Zhong, 2018).

Xia and Zhong (2018) reviewed 22 research studies on teaching and acquiring robotics topic knowledge in K-12 and discovered that the majority of the studies focused on primary school pupils, who typically learnt using LEGO robots. Furthermore, research studies have shown that robots may serve as tutees, tutors, and learning tools. For example, Chandra et al. (2020) investigated the impact of children's handwriting abilities by using a Nao robot as a tutee and children as tutors to teach the Nao robot handwriting.

Theory Involved in Learning with Robots

Robotics has been linked to constructivism (Bauerle & Gallagher, 2003). The constructivist teaching and learning philosophy emphasizes the instructional value of activities such as those provided by integrating robots into educational practice. These kinds of tasks allow students to create interactive thinking objects and are grounded on the principle of learning by construction. As they work on their items, students evaluate, alter, differentiate, redesign, rebuild, and reprogram them. Students' creation of these items aids in their representation of reality. In this setting, in which they participate actively, students comprehend the relationship between theory and practice, connecting the abstract to the concrete and connecting what they learn in the classroom to the outside world and natural world. Students may take charge of their education in a constructivist classroom; they are free to explore and make their own decisions. It encourages a student-centered atmosphere in which learners actively participate in the teaching and learning process via social contact and teamwork (Sullivan & Moriarty, 2009).

Types of Educational Robots Used as Learning Tools

The different types of educational robots used as learning tools are listed in Table 1.

Table 1. Types of Educational Robots Used as Learning Tools

Sr. No	Name	Application	URL
1	LEGO Mindstorm	It may instruct students in several areas, including language, robotics,	https://education.lego.com/en-

		programming, and computer science.	**us/downloads/mindstorms-ev3/software/**
2	Nao	Through a "therapeutic process," it is utilized to engross pupils with learning challenges in real-time activities, such as education treatment. There are several programming languages available, such as Java, C++, and Python.	**https://www.aldebaran.com/en/support/nao-6/downloads-softwares**
3	The BeeBot	It's a social robot designed specifically to teach basic programming and math topics to younger kids. It is inexpensive as well as simple to use. In addition, it may be used to teach program sequences, repetitions, directional and positional language, control and sequencing, and algorithm comprehension.	**https://focus-on-bee-bot-1.software.informer.com/3.0/**
4	Vex IQ	Traditional programming is carried out using Vex IQ.	**https://www.vexrobotics.com/vexcode/install/iq**
5	Thymio	Students may learn robotic language with the help of a little robot called Thymio. This robot is reasonably priced and simple to program.	**https://www.thymio.org/download-thymio-suite/**
6	Kaspar	It is a humanoid doll that supports educators and parents of kids with autism and other severe communication disorders. Kaspar's expressive face cut was purposefully designed that way since autistic kids have trouble reading facial emotions and understanding speech (Wainer et al., 2014).	**https://www.herts.ac.uk/kaspar/the-social-robot**

CONCLUSION

Robotics in education has a promising future because it can revolutionize the way we impart knowledge, learn it, and interact with it. The advantages of this technology

are becoming more obvious as researchers investigate and incorporate robots into the classroom; this opens the door to more individualized, interesting, and successful learning experiences. Engineers, educators, and legislators must work together to remove the obstacles and seize the possibilities that robotics brings to fully achieve this promise. By doing this, we not only improve student results but also set them up for success in a world where automation and robotics are commonplace. As students gain proficiency in directing robots, perhaps even top-rated essay writing services, we get closer to a future in which education is more accessible, participatory, and suited to each learner's specific requirements.

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