

Educational Robotics in Distance Education and The Role of The Teacher

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ABSTRACT: With the appearance of Distance Education (DE) methodologies and approaches in education, the field of teaching has changed radically. With the parallel development of technology, new paths and opportunities have been created to enrich education with new creative methods. This article examines the evolving landscape of Distance Educational Robotics (DER), with reference to the critical role of teachers in guiding and facilitating quality educational experiences. Through an extensive literature review, this study examines the benefits and challenges associated with integrating Educational Robotics into Distance Education. It briefly reviews the platforms and tools that facilitate the implementation of DER and explores various pedagogical strategies and instructional designs that educators can use to maximize the effectiveness of DER, considering the diverse learning needs and capabilities of students. It also emphasizes the importance of continuous professional development of teachers to improve their competence in remote pedagogic practices and the use of technology.

In conclusion, the study illuminates the dynamic relationship between DE and Educational Robotics and the role that the teacher acquires by combining the two. Highlighting the roles and complexities of teachers' responsibilities, the article offers methods and suggestions that can guide and support their efforts to create organized and effective teaching.

KEYWORDS: Educational Robotics, Distance Education, Teacher's Role, School Education

I. INTRODUCTION

With the outbreak of the Covid 19 pandemic, education was faced with an unprecedented situation. Amid the insecurity and fear that prevailed among the citizens, education in both schools and universities had to continue. Thus, for the first time in Greece, Distance Education was implemented at all levels, in the context of urgent remote teaching (Anastasiadis, 2020; Liakopoulou & Stavropoulou, 2021). This resulted in the immediate and urgent effort to integrate technology into educational practice.

The teaching methods applied by teachers during Distance Education are important to meet the needs of students and to be distinguished by pedagogical characteristics, especially when it comes to primary education (Sahlou et al., 2022). Communication with the teacher is of great importance and it is necessary for him/her to be familiar with new technologies so that he/she is present whenever the learner needs him (Zygouris & Mavroidis, 2011; Karvounis & Anastasiadis, 2019). Educational Robotics has appeared in the field of education in recent years and many teachers use it as a teaching and learning tool, but many are not familiar with it (Pasilidou et al., 2021; Vicente et al., 2021; Shatunova et al., 2019; Karatrantou & Panagiotakopoulos, 2011).

The article consists of the introduction and the purpose of research and then follows the methodology of our research. In the first section, there is a short introduction to Distance Education and how it was implemented for the first time in Greece, as well as the benefits it has for students. After that, a brief reference is made to digital transformation, which follows a reference to Educational Robotics, what exactly it is and how it is applied during teaching. The next section refers to Educational Robotics and skill development based on Constructivism theory. It focuses on the theory of Constructivism and its benefits in education, as well as the benefits that Educational Robotics offers to learners and the importance of Educational Robotics for school education. The next section mentions the ways in which Educational Robotics activities can be developed to work effectively for students and references are, also, made to the role of the teacher during Distance Education and Educational Robotics respectively. In the last section, a reference is made to the combination of Distance Education and Educational Robotics and to the role that the teacher acquires. Finally, there are the conclusions of the work and the suggestions for teachers to use Educational Robotics

II. AIM OF STUDY

In recent years with the development of technology and the implementation of Educational Robotics in the educational process, its application in the classroom and how it can be used in real-life, have been explored significantly (Karemyllaki, Karatrantou &

Educational Robotics in Distance Education and The Role of The Teacher

Panagiotakopoulos, 2022; Sahlou et al., 2022). However, the utilization of Distance Educational Robotics has not been yet, sufficiently explored. In this lies the importance for investigating the subject to highlight the ways in which Educational Robotics can be combined with Distance Education. The purpose, therefore, is to investigate the ways in which Educational Robotics can be integrated and combined with Distance Education, to help students be led to knowledge.

The study aims to contribute to discussion about the research question: In what ways would Educational Robotics be utilized in Distance School Education?"

III. METHOD

The method that was chosen for this study was a literacy review. As part of the research Greek and international literature were reviewed. Databases such as ResearchGate, Scopus, Google Scholar, Springer International Publishing, the National Documentation Center, the journal for Open and Distance Education and Educational Technology, the Hellenic Scientific Association of Information and Communication Technologies in Education (ETPE) and the Education Sciences. Search filters were limited from 2019 to 2023, with a few exceptions where searches covered the period 2011-2023. Key words were used during the search, some of which were Educational Robotics, distance education educational robotics and the role of the teacher, etc.

IV. FINDINGS

Below the findings of the study are presented, focusing on the role of the teacher in distance education and the difference encountered in recent years. The findings describe the benefits of educational robotics and the skills that can be cultivated, with their use, based on the utilization of the Constructivist Theory. Moreover, the importance of Educational Robotics for school education, the development of ER activities, as well as the benefits of the combination of Educational Robotics and Distance Education are, also, discussed.

A. Distance Education

Distance Education brought radical changes and innovation to the field of education. After the 1950s, there were several conditions that favoured the modernization and development of education, thus distance education was also developed (Lionarakis, 2005). Distance Education is closely related to self-regulated learning. By engaging with online platforms, students develop proficiency in using digital tools, communication technologies, and online collaboration platforms. These skills are very important in today's job market and help to strengthen digital literacy. Distance Education encourages lifelong learning by providing opportunities for continuous training and skill development (Lionarakis, 2006; Tselegkaridis & Sapounidis, 2022; Clark & Barbour, 2023).

B. Educational Robotics

In recent years, digital transformation has emerged as an important vehicle in the strategic research and development of the educational process. To a large extent, digital transformation encompasses the profound changes taking place in society and industries through the use of digital technologies (Majchrzak et al., 2016). The rapid pace of new technologies has accelerated change in education and schools are forced to place themselves at the centre to radically transform the educational process (Oliveira et al., 2022; Bogdandy et al, 2020). The culture and behavioural experience of both learners and teachers are critical factors in the emergence of educational innovation.

Industrial Robotics is a branch of Robotics that has become of utmost importance to science and industry in the last century. The presence of robots has revolutionized the industrial environment in just a few decades. Robotics has been applied in many fields and professions in recent years. It has helped to improve, develop and evolve industries and science (Gasparetto & Scalera, 2019).

The term "Educational Robotics" refers to a field that aims to improve students' learning experiences through the creation and application of robot-related activities, technologies, and objects (Angel-Fernandez & Vincze, 2018). The concept of educational robotics aims to promote a range of skills such as initiative, responsibility, autonomy, creativity and teamwork. Educational Robotics helps students' social skills and self-esteem, which translate into stronger motivation and can have global implications. From an educational point of view, it can be considered that Educational Robotics enhances creativity (Aris & Orcos, 2019; Silva et al., 2023; Karatrantou et al., 2023a). Through Educational Robotics, students are challenged to design, build and program their own robots, giving them a sense of autonomy and responsibility in their educational experience (Benitti, 2012; Zhong & Xia, 2020; Gratani et al., 2021).

1) Educational Robotics - Skills Development Based on Constructivism Theory

Constructivism can be defined as a set of teaching methodologies that prioritizes the student as an agent of knowledge construction and understanding.

The main position of constructivism is that learning is a process of adapting and leads the learner to new knowledge in an active way. Active learning is a key parameter of constructivism and encourages the learner to participate actively and creatively in

Educational Robotics in Distance Education and The Role of The Teacher

teaching. Applying constructivism to teaching and learning environments can make learning more meaningful and qualitative (Mohammed & Kinyó, 2020; Merve, 2019).

Constructivism, constructionism and social constructivism, are widely known and accepted theories of learning. For the application of these methods in the teaching of STEAM fields, activities that involve and use robotic kits are the most suitable. Typically, they are designed as project-oriented activities in which students work in smaller groups to jointly build a robotic model and program its behaviour. In addition, with these activities, students, also develop interpersonal teamwork skills as well as communication skills (Veselovská et al., 2020).

2) Benefits of Educational Robotics

Educational Robotics is essential to education as it offers a special and unique method for teaching skills essential for success in the 21st century. To thrive in today's world, students must be able to think critically, solve complex problems, work collaboratively, and be prepared for the rapid technological developments taking place (López-Belmonte et al., 2021).

One of the advantages of Educational Robotics is that it allows students to learn by doing. Students are able to apply the concepts they learn in the classroom to real-world problems and can immediately see the results of their work taking shape. This approach to learning is very interesting, motivates and encourages students (Talan, 2021; Tsagaris et al., 2019). Another advantage of Educational Robotics is that it encourages students to be creative and innovative. Robotics projects often require students to think outside the usual answers and boundaries and find unique solutions to complex problems. Creativity is important to cultivate and give students the opportunity to have corresponding stimuli that will allow them to develop these abilities (Tsagaris et al., 2019; Gubenko et al., 2021; Karatrantou, et al, 2023b.).

While working on robotics projects, students may encounter challenges, crises, and tensions, but they are encouraged to keep trying and learn from their mistakes. This type of learning fosters resilience and accountability on the part of students (Piedade et al., 2020; Tzagkaraki et al., 2021; Yudin et al., 2020; Karatrantou, Stergiopoulou & Panagiotakopoulos, 2022). However, it also offers teachers benefits that are not easily accessible in the context of traditional teaching. They can organize their teaching in a variety of ways using several applications that can be adapted to the needs and abilities of the students (Karatrantou & Panagiotakopoulos, 2011; Alimisis, 2020).

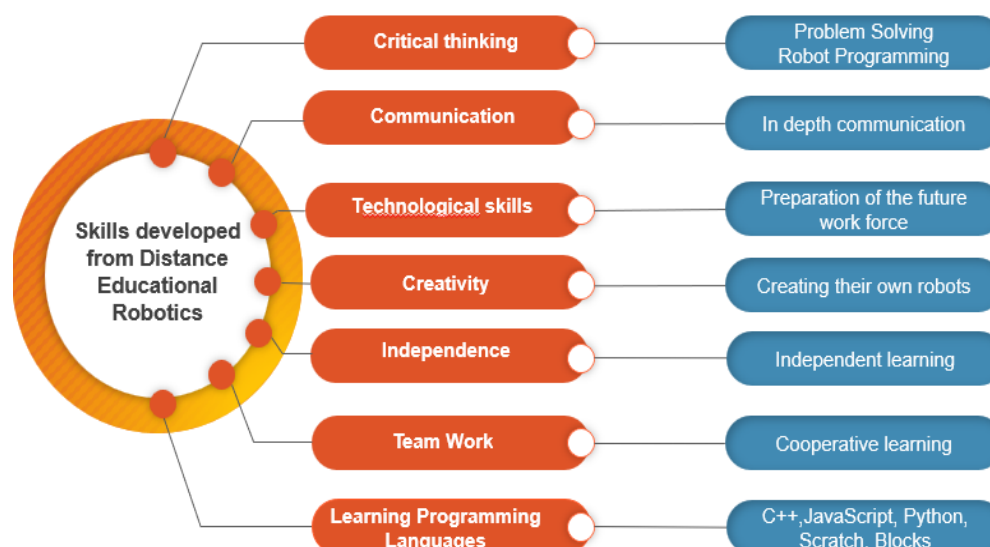


Figure 1: Skills developed using DER.

3) The Importance of Educational Robotics for School Education

The pedagogical motivation for connecting robots with students is the assumption that creativity can be fostered through interactive human-machine interactions (Gubenko et al., 2021). Educational Robotics helps learners develop their abilities and skills through a variety of activities. Cultivating critical and computational thinking, collaboration, creativity and metacognition, gives students the opportunity to have access to their future work environment. Regarding the skills that teachers consider useful for students' daily lives, they, also, seem to believe in children's ability to work in groups and gain everyday experiences (Piedade et al., 2020; Tzagkaraki et al., 2021; Yudin et al., 2020).

Learners, through interacting with each other and solving problems, build and develop their personality. In any case, the activities should be in harmony with the needs and abilities of the students and be of escalating difficulty, with the continuous, of course, support of the teacher (Tzagkaraki et al., 2021).

Educational Robotics in Distance Education and The Role of The Teacher

4) Designing of Educational Robotics Activities

Many teachers have faced situations where one or more reluctant students refuse to participate in a class and share their opinion with their classmates. These learners need help to overcome their inhibitions, start conversations and get to know other peers. To promote the necessary safe environment, teachers can organize simple activities to help learners adjust. Activities that can help students feel more familiar and engaged are usually introductions that can help start a lesson, stimulate student attention and curiosity about a topic, help group bonding, and help participants feel comfortable. Introductory activities are usually short and may include writing, dialogue, group discussions and physical activities. Such activities have the purpose of bridging the relationships of both the students with each other and with the teachers (Sapounidis & Alimisis, 2021).

In the research of Sapounidis & Alimisis (2021), it is stated that the lack of appropriate support for students during collaboration can have a negative impact on their participation in other collaborative activities as well as on their performance during the learning process.

Research by Toh et al., (2016) showed that the use of the robot in various activities with young children supports constructivism as a learning method. Students discuss, solve problems, collaborate with their peers, and combine their knowledge to build their robots. Such activities can be designed for students from elementary to graduate level and may involve programming, implementing, or experimenting with robots. Educational Robotics activities usually consist of using a robotics kit, with which children learn how to build and program robots.

C. The Role of the Teacher

The role of teachers has been transformed dramatically through the years, moving beyond delivering content to become mentors and facilitators in students' broader development. Now, teachers foster critical thinking and independent learning by encouraging students to explore and problem-solve on their own. As digital navigators, they help students use technology safely and responsibly, while as mentors, they focus on social-emotional growth through personalized support and encouragement. Teachers also work to create inclusive, responsive classrooms that support all learning styles and backgrounds, helping students build empathy and global awareness. They increasingly use data to give instruction to individual needs, enhancing learning outcomes in real time. Beyond that, teachers are now, also, focused to students' well-being, recognizing that mental and emotional health are essential for success. Additionally, they advocate for innovative changes within schools and communities, leading initiatives that incorporate new teaching technologies, sustainability, and inclusivity. By balancing their many roles, today's teachers are essential in shaping not only academic success but also the personal and social growth of future generations (Woods, 2021; Bishop et al., 2020).

1) The Role of the Teacher in a Distance Education Environment

In a Distance Education environment, the role of the teacher is even more as it is important to ensure that students receive effective instruction and support. Teachers must act as facilitators of learning, providing students with guidance while creating an environment that encourages collaboration and engagement (Moore, 1993; Spector, 2014; Papadakis & Kalogiannakis, 2022).

It is important for teachers to be available to students through various means such as email, video conferencing, and forums to interact with students and address their questions and concerns. The teacher must also respond to the needs of the students to ensure that they feel supported and encouraged (Bernard et al., 2009; Palloff & Pratt, 2007; Simonson et al., 2015). A teacher must ensure that the lesson is well structured and organized. This includes setting clear learning objectives and creating a course outline (Palloff & Pratt, 2007; Simonson et al., 2015). Another critical aspect of teaching in a Distance Education environment is the use of technology to enhance the learning experience. Educators in blended learning should use a variety of digital tools and platforms to enhance instruction and provide their students with engaging content, such as videos, interactive simulations, activities, and assessments (Garrison & Kanuka, 2004; Simonson et al., 2015; Papadakis & Kalogiannakis, 2022). In addition, constructive feedback to learners is very important during a distance learning program (Piedade et al., 2020). In addition to on-time feedback, it is also important that teachers regularly assess student progress. This helps students understand their strengths and areas for improvement, while also giving them a sense of accomplishment and motivation to continue learning.

2) The Role of the Teacher in Educational Robotics

The role of the teacher during the implementation of educational robotics is important, as he must properly support the learners to successfully complete the learning activities. The activities involved in Educational Robotics are important motivations, mainly in primary education (Inepologlou et al., 2021).

The importance of the teacher's role in the integration of technology in teaching and learning processes is undeniable (Silva et al., 2023). The teacher should be competent in the handling of technological tools and be able to utilize the specialized knowledge necessary to create conditions that promote learning. Therefore, there is a need to promote the professional development of teachers (Silva et al., 2023; Oliveira et al., 2023).

Teachers in Distance Education play a new role, different from that in traditional teacher-centred teaching. They support and guide learners in order to teach them how to lead themselves to knowledge (Kappou, 2020. Filippidis, 2018). Teachers, therefore,

Educational Robotics in Distance Education and The Role of The Teacher

try to encourage and promote the autonomy of students by creating a comfortable environment for expression while acting as guides to make their teaching more constructive.



Figure 2: Distance Learning requirements

D. Combining Distance Education and Educational Robotics

As Distance Education becomes more popular, educators are finding new ways to incorporate Educational Robotics into online learning environments. Using virtual simulations, remote robotics kits, video tutorials, and virtual competitions, educators can provide students with engaging and interactive learning experiences that encourage critical thinking, collaboration, and creativity (Falloon, 2011; Tselegkaridis & Sapounidis, 2022). One approach to integrating educational robotics into Distance Education is through Virtual Robotics Simulation. Some platforms such as Robot Virtual Worlds and Coder Z even allow students to collaborate with their peers in virtual environments (Papadakis & Kalogiannakis, 2022; Choi et al., 2021). Another option is to provide students with remote access robotics kits. Companies like LEGO Education and VEX Robotics offer robotics kits that can be shipped to students' homes. These kits usually come with online instructions and tutorials (Alimisis, 2020; Barone, 2021). We notice, therefore, that the role of the teacher during Distance Education and Educational Robotics have many common elements and features, without particular differences as we will see below in Tables 1 and 2.

Table 1: The role of the teacher in Distance Educational Robotics

Role of the teacher	Teachers' actions/ Students' Benefits
Facilitating learning	Interact with students and address their questions and concerns, offering opportunities to interact and practice an ensuring that they are supported to make their own decisions, respected as individuals, and trusted with responsibility
Provide guidance to students	Guiding learners through activities, instructions and proper communication offering effective scaffolding
Encourage cooperation	Provide activities for students to develop group cohesion during all phases of a learning procedure (group icebreaking activities, team-building activities, designing-constructing-programming the robotic construction, reflection exercises/discussions) using synchronous and asynchronous tools and approaches
Providing engaging content to students	Tools such as videos, interactive simulations, activities and assessments virtual workshops, lectures and discussion forums
Creating a sense of community among students	Increase teamwork and encourage discussions through online forums and apps, decreasing the 'distance' among students
Establish clear communication channels	Teachers are available to students through various means, including email, chat, video conferencing, forums. Direct and clear communication with the teacher leads learners to acquire knowledge in a more intriguing way

Educational Robotics in Distance Education and The Role of The Teacher

Table 2: Ways to implement the teacher role in Distance Educational Robotics

Teachers' Responsibilities/actions	Educational results
Organized lesson planning	Well-structured course, with rich teaching material. Having a detailed curriculum and setting clear learning objectives is essential
Provide information on course structure and assessment methods	Ensuring that students know what is expected of them and what goals they need to achieve
Responding to learners needs and make them active participants	The teacher adapts the teaching to the needs of the students and creates a safe space of expression where learners move at their own pace towards knowledge
Providing students with access to relevant learning resources	Properly organized context, between the teacher and the student. Students have access to textbooks, journals and articles
Familiarity with new technologies by using a variety of digital tools and platforms	Proper guidance and help to students in order to search and explore the part of teachers for new tools they can use
Provide timely and constructive feedback to learners	Constructive feedback to learners with extensive analysis of the corrections they need to make
Regular monitoring of student progress and participation	Identify learning gaps or issues and take appropriate action to address them

V. CONCLUSIONS

Distance Education can offer many positive elements in the educational process if it is used correctly and sufficiently. Educators are taking on new roles, such as that of mediator of knowledge, one who provides guidance to learners and encourages collaboration among them as well as one who encourages students to be actively involved in teaching, responds to the needs of students and uses a variety of digital tools and platforms. However, for this to happen, proper education and training of teachers is necessary so that they are familiar with the new technological requirements that arise. At the same time, Educational Robotics can enrich teaching creatively and in combination with Distance Education it enables teachers to organize their lesson appropriately and adapt it to the needs of their students. Thus, the role acquired by the teacher during Distance Educational Robotics requires specialization, training and essential communication with the students. Distance Educational Robotics can contribute qualitatively and creatively to education. Through virtual simulations, remote robotics kits, video tutorials, and virtual competitions, educators can provide learners with creative learning experiences that encourage critical thinking and collaboration. In addition, the application of Remote Educational Robotics can also be done through platforms, such as that of Robot Virtual Worlds, which allow the collaboration of learners in virtual environments as well as through remote learning kits such as kits from Lego Education, which allow the familiarization of students with Educational Robotics even from their place. So, the smart application of learning strategies and technology can mark the transition from theory to practice and effectively help students to lead themselves to knowledge.

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Educational Robotics in Distance Education and The Role of The Teacher

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