APPLICATION OF EDUCATIONAL ROBOTS IN TEACHING

Armin Čelarević[1], Ilma Mrakić[1]
[1]Internacionalni univerzitet Travnik u Travniku

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SUMMARY

Robots in education fall into two categories: robots used to teach children about STEM subjects and the more recent application of robots as teachers. The use of robots in education is largely unknown to both researchers and teachers. Developers and educators have questions about essential applications for robots used in education. Educational robots are used to enable students to acquire skills in a range of science, technology, engineering and mathematics disciplines, which are increasingly important in a world where technology is advancing rapidly. The potential for robotic technology to have a profound impact on society, both economically and socially, is enormous. The way people live and work in the world is largely influenced by technology. In order to make learning more pleasant and easier, the education sector is adopting robot teaching assistants in schools. Robotics can be used in education to help develop new methods and strategies. Robotics makes learning easier and thus introduces students to robotics at a young age. In primary education settings, students can learn how to build and program a robot to perform a range of basic tasks.

Keywords*: Robotics, Education, Artificial Intelligence, STEM*

1 INTRODUCTION

Robots in education are commonly used as a tool to teach STEM (Science, Technology, Engineering and Mathematics) subjects. One of the most promising applications of robotics is service robots designed for educational use, which has great potential as an educational technology. The use of robotics can contribute to education in many ways. One contribution is that they provide great benefits as a teaching tool. They have many useful features that make them useful for teaching when they match the learning objectives. Robots are flexible, allowing teachers to propose different models for a wider range of educational uses. Also, they can facilitate learning. The use of robots provides students with fun activities and hands-on experiences that help create an engaging, attractive and interactive learning environment. Robots have been found to be motivating and engaging for students and are becoming an effective tool for improving student motivation and learning performance. More than improving student learning, robotics is seen as a useful learning technology that supports the development of learning skills in the 21st century. Robotics is most often used in STEM education, usually as a team design project where students are provided opportunities to communicate with each other. The advantages of robotics highlight the great potential of using robots as educational tools. The current state of educational robots indicates an urgent use to research important applications of such robots. Much remains unknown and unclear about the use of robotics in other learning subjects and for other age groups, making the use of robots in education problematic. Students investigate and solve problems by working with robots. Working with robots allows them to move from the abstract to the concrete, and active learning is encouraged. Educational robots are also extremely useful for children with autism spectrum disorder. They help them develop social skills more easily. Through artificial intelligence, i.e. educational robotics, individualized learning is enabled for students. In the last few years, a new application of robots in education has emerged. Fueled by advances in robotics and artificial intelligence, social robots are now being explored as teaching assistants. Social robots are robots that interact with humans using the same channels of interaction that are used in human-to-human communication. They use speech, facial expressions or body language to communicate. They are often designed to have visual appeal, and their software is customized to allow social interaction to flow. In the last few years, the potential of social robots has been explored in education, and a number of studies show that robots have significant potential in formal home education**.**

2 Robotics

When robotics first started to develop, it was mostly still closely related to the development of manipulators such as mechanical arms with elbows, joints, grippers or some tools. Over time, robotics developed to the point that those hands became dexterous enough to successfully handle eggs and paper cups without breaking or crushing them. After the mobility of robots was achieved, various new ideas came up, robots that swim like fish, fly, etc. Due to the simplicity of manufacturing and design, wheeled robots have become the most popular, but they are limited by the type of terrain they can move on. Advances used in the field of artificial intelligence have great potential to provide some benefit. Like all technology, robotics and artificial intelligence have their positive and negative sides. The difference is only in the point of observation - what is useful to a person and what is negative. Application of robotics in education:

- Supports skill development: robotics improves students' skills by strengthening their knowledge through

the design, construction, assembly and operation of robots. Students can interact with mechanical and electrical processes, which can make learning more fun.
- Experience in a real school: educational robotics can be a solution for all students who are unable to attend school.
- Special student opportunities: Robotics in the classroom is a great way for students to learn. It gives them access to the information they need. Individual needs can be met by programming robots.
- Finding interests: robot programming allows students to identify their interests. These include engineering, science, technology and programming.
- Creativity: robotics is an innovative science that combines engineering and creativity. This enables the participants to learn. In this way, students' creativity is increased and it helps them to retain more information.

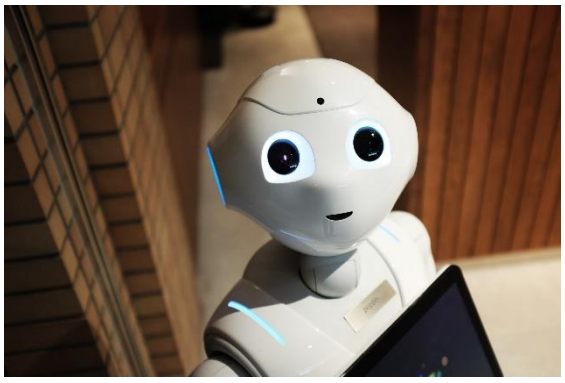

Figure 1. Robot

Source: https://pcchip.hr/ostalo/umjetna-inteligencija/ (19.05.2023)

In robotics, there are many things that can be done with artificial intelligence as robotics continues to improve exponentially. Incorporating new technologies into the education sector can improve interdisciplinarity and create a learning environment that allows teachers to help students develop their creativity. Robotics has the potential to bring positive benefits to education. Educational robotics encourages students to take an active role in their learning and develop their own knowledge through active methods.

2.1 Artificial intelligence

Artificial intelligence refers to the simulation of human intelligence using software code. Artificial intelligence is based on the principle that human intelligence can be defined in such a way that a machine can easily imitate it and perform tasks from the simplest to the most complex. The goals of artificial intelligence include mimicking human cognitive activity. As technology advances, the previous benchmarks that defined artificial intelligence are becoming obsolete.

Artificial intelligence is continuously evolving to benefit many different industries. The software is wired using an interdisciplinary approach based on mathematics, computer science, linguistics, psychology and more. Artificial intelligence can be divided into two different categories: weak and strong. Weak artificial intelligence embodies artificial intelligence systems including video games like chess and personal assistants like Amazon's Alexa and Apple's Siri. For example, ask an assistant a question and he will give you an answer. Powerful artificial intelligence systems are systems that perform tasks. These are usually more complex systems. They are programmed to handle situations where they may be required to solve problems without human intervention. These types of systems can be found in applications such as automobiles or hospital operating rooms. Artificial intelligence can be organized in several ways, depending on the stages of development or actions:

- Reactive machines: artificial intelligence that only reacts to different types of support based on pre-programmed rules. It does not use

memory and therefore cannot learn with new data.
- Limited memory: considered to be the most modern artificial intelligence. Over time, it can use memory to improve by training with new data.
- Theory of Mind: It is fully adaptive and has an extensive ability to learn and retain past experiences. These types of AI include advanced chatbots that could pass the Turing Test, fooling a person into believing that the AI is a human being.
- Self-aware artificial intelligence is an intelligence that, as its name suggests, is aware of its own existence. Still the realm of science fiction, some experts believe that artificial intelligence will never become conscious.

Figure 2. Goals of Artificial Intelligence

Source: https://repozitorij.hrstud.unizg.hr/islandora/object/hrstud%3A2898/datastream/PDF/view (19.05.2023

With the help of artificial intelligence, it is possible to recognize "knowledge gaps" in every student. Materials with appropriate content and step-by-step solutions for complex problems can be submitted to the student. The availability of education at any time can be highlighted as one of the most important advantages of artificial intelligence.

2.2 Robotics in teaching

Education is one of the areas of society that artificial intelligence has the potential for the most positive impact. Robots can be a valuable teaching tool, but it is important to implement them correctly for the best possible results. The inclusion of robots in education is a modern alternative that is becoming increasingly popular for supplementing teaching at all levels. Robots are attracting the interest of teachers and researchers as a tool for developing cognitive and social skills for learning from preschool to higher education. This way of learning offers practical and fun activities that increase the interest and curiosity of students. Learning with the help of robots is based on constructivism, i.e. the realization that the construction of knowledge is based on one's own experience. The primary goals of this class are focused on developing skills to solve certain problems. Features for teaching robotics in schools:

- Fun for children: video game design and robotics are proven to be the most successful for learning information technology.
- An effective way of learning programming: by programming robots, students learn to program and learn basic commands.
- Learning skills for future employment: due to the increasing use of mechanical equipment, the need for programmers and the need for programming knowledge are growing.
- Suitable for the development of children with different abilities: robots provide clear and calm reactions, which is most suitable for children with autism. The best developed robot for children with autism is the NAO robot, which provides specially developed games.
- Demystifying complex technologies: working with robots is considered to break the fear of unknown technologies.

By introducing robotics into the curriculum, the plan encourages students to learn programming. Such learning increases interest in STEM. The purpose of this learning is for the new generations to develop their creativity, thus expanding the scope of education and connecting the solution to problems with the knowledge they have previously acquired. By posing problems, he encourages students to investigate, be creative, reliable and responsible.

2.3 Educational robots

Through robot education, knowledge about robots, informatics, mechanics and electronics is acquired, based on which it was concluded that the robot represents the most complete and complex mechatronic object. By introducing robotics into the education system, it is not only about learning about robots, but also about learning with robots. The best way to learn is when students learn about robots through building them and solving problems. By introducing robotics into the educational system, students are encouraged to develop technological creativity through the creation of new, more efficient and environmentally friendly automated technical trends. Educational robots are being developed with the aim of solving problems in the educational system.

According to the form, virtual and physical educational robots differ. A virtual robot is also called a software robot. These are robotic source files that are generated through programming and coding in a computer simulation environment. This type of robot helps reduce the cost of maintaining and operating physical robots. For this reason, they successfully increase the availability of equipment and reduce the complexity of technology. These robots are also widely used in education, and often serve as a platform for learning and innovative practice. Physical robots are suitable for students' hands-on activities because they can provide a higher-level interaction experience. Robots according to function in education are divided into:

- Robots that apply discipline: these robots are characterized by comprehensiveness and complexity. They are used for the discipline of robots and are associated with STEM education in schools and colleges, through which they strive to develop students' practical ability and problem-solving ability.
- Robots with a teaching service: they are used as an auxiliary element in the teaching activity, with the aim of providing students with educational fun. With the help of intelligent learning toys, these robots can help teachers to end the lesson more effectively.

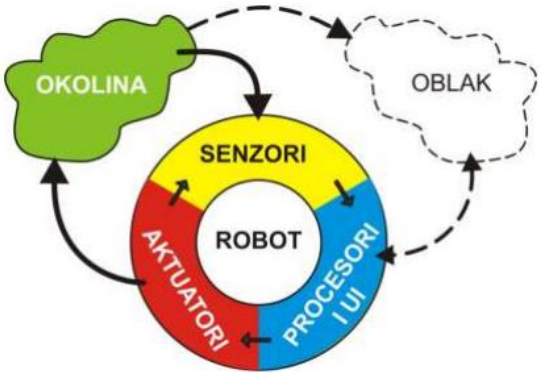

Image: Mode of operation of robotic systems

Source 3. https://hro-cigre.hr/wp-content/uploads/2022/02/Nikolic-Transformacija-pojma-robot.pdf (20.05.2023)

Robots have proven to be very useful for children with developmental disabilities. Children with developmental disabilities show greater motivation and self-confidence in their environment. In order to create such an environment and help children in therapy, the robot CosmoBot was developed. Doctors use it in therapy with children from 5 to 12 years old. Therapy is interesting for children, and

therefore therapy achieves better results. Elias, a socio-educational robot, helps teachers in the area of language, is one of the robots used in schools. The robot is controlled via a mobile application. This robot includes complete, ready-made, and high-quality language courses for eight languages: English, Spanish, French, Italian, German, Chinese, Finnish, and Swedish. Quiz exercises can be used to refresh knowledge. The robot's speech rate can be adjusted to match the student's skill level. Speech recognition is accurate and the learner experiences success, even if the pronunciation is not quite at the level of the native language. In addition to speech exercises related to teaching, the student can also practice communication and response skills with the robot through free-form conversation.

2.4 The influence of the robot on the child

The role of robots in play or education, appropriate for the age of the child, is mainly related to the social behavior of the robot. It is known from pedagogy that learning in a group is much more useful than individual learning. A robot with the "physical appearance of a human" with the expression of emotions would be suitable for assisting with certain teaching subjects. If the child sees that the robot is interested in all the things that the child is interested in, he will realize that he is similar in interest, so he will establish a relationship with him. Which means that the robot is able to communicate non-verbally with the child. Once the child has established communication with the robot, more sophisticated interactions can be included. Social interaction is very important. The robot has the ability to record every answer that the child gives and thus follows him for some time. The robot knows exactly what the child has adopted and what problems he has. Only then is it possible to apply a curriculum that is optimal for the child's age and interest. Thanks to the robot, it is possible to create an individualized form of education based on the collected information about that child in the robot's memory. When learning with a robot is applied to older children, the tasks will be much more complex. Robotic education, education with robots, education with the help of robots are some of the terms for education in which the robot plays the role of assistant or assistant. Educational robots must adapt to interest, age, previous knowledge, and above all, they must arouse children's interest. Special robots will be required with a customized appearance, work function, construction method, but also special software for various age groups. It is necessary to pay close attention to each mentioned segment, because such robots will be integrated into the lives of young people. Robots can be a very fun platform for learning about music, languages, computers, electronics and the like. Educational robots are part of the new educational technology. With them comes the improvement of education as well as the facilitation of learning. Robots are just another of the new tools, new technologies in the function of facilitating the education process. The advantage of education with the help of robots is very important for all children, which means that educational robots should be aimed at the whole class and not only at talented children.

2.5 Robotics in school

The use of robots, robotic technology is especially prevalent in technical schools that have courses related to robotics. Day by day, robots are increasingly attracting the interest of teachers, professors and researchers as a tool for the development of social and cognitive skills for students from preschool to higher education. Learning science, math and technology is much easier for students with the help of robots.

This way of learning provides fun but also practical activities that arouse interest and curiosity in students day after day. Constructivism, that is, the realization that

the construction of knowledge is based on one's own experience, is actually the basis of learning with the help of robots. The basic role of a teacher or professor is to provide students with the possibility of practical work and research, thus ensuring that children construct their own knowledge. Working with robots creates a special kind of environment, one where students have the opportunity to solve real-world problems. This makes robots an excellent tool for children who thus acquire a constructivist way of learning. The majority of schools still do not support advanced technology and thus its use, which means that the competences needed in the XXI century cannot be developed in this way.

2.6 STEM

STEM is an acronym that refers to several academic disciplines, namely: Science, Technology, Enginnering and Mathematics. Science is a very broad field and serves to better understand everything that surrounds us. And in order to make the things that surround us, engineering is needed. What affects the changing of the world and what is an integral part of our everyday life is technology. All these disciplines rely primarily on the mathematics we apply. In order not to study all these disciplines separately, STEM is here to unite them, so we can study them together. The reason for the population of this way of learning is the lack of students in some fields of STEM. More precisely, the lack of manpower in this area. The school system is outdated and does not follow trends in employment, so it is necessary to change school systems in order to improve the quality of learning and teaching. Traditional education differs from STEM education in that scientific methods can be applied in everyday life situations.

2.7 Micro: bit

The Micro:bit is a microcontroller on a chip with a 32-bit ARM Cortex processor.

A microcontroller represents a computer in miniature, and its function can be programmed. The microcontroller was developed by the BBC, Microsoft and others and presented as a new technology, and the main goal for which it was created is mass involvement in schools, primarily for STEM education, but also for other subjects. It can be programmed from any web browser in JavaScript, Blocks, Python, Scratch and many more. It is used in school as a teaching aid. The price and the possibilities it provides are one of the most important and important features that have made it popular.

Micro: bit consists of:

- 25 LEDs arranged in a 5x5 field (can be programmed separately)
- **programmable buttons**
- Physical connections (pins)
- Sensors for light and temperature
- Motion sensors (accelerometer and compass)
- Wireless communications (radio and bluetooth)
- USB header

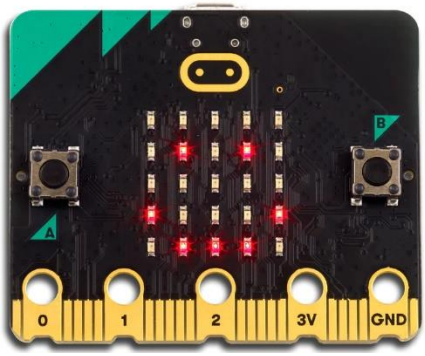

Figure 4. Micro: bit

Source: https://microbit.org/get-started/user-guide/overview/ (20.05.2023)

Micro: bit has a limited capacity in relation to the complexity of the programs that are prepared during learning on this device. It has a low consumption, a speed of 16 MHz

and an integrated working memory of 16 kB and support for Bluetooth, which is a very important part of the device. Bluetooth provides an alternative data transfer option. The USB header represents the connection to the computer, that is, the connection to the rest of the world. Thanks to the USB header, it is possible to charge the device and download programs.

The speed meter is an accessory that measures the speed and position of the device.

Changes in the device's position and changes in the Earth's magnetic field are measured through the compass. In order for the micro:bits to communicate, a radio is set up. LEDs can display text, numbers and an image. The keys are marked with A and B. Pressing key A starts the program, and pressing key B interrupts a specific operation. Micro: bit has a total of 25 pins, 6 of them are used for power supply, and the remaining 19 are used for input/output units (sensors and similar peripheral devices). The maximum current strength per pin is 5mA and there can be a maximum of 3 of these in the drive. Micro:bit was created for learning programming and not for developing electronics.

2.8 Step into the future

Robotics is a new dimension of the scientific and technological field. Technological - scientific progress and the development of artificial intelligence as one of the most important factors. Robots are becoming smart work partners for humans. Today, robots can perform tasks in medicine, service activities, household tasks and the like. The development of robots in the XXI century is aimed at various applications. In the near future, robots will resemble humans, both physically and intellectually. It will be like humans even more than that. Given that they will fit in perfectly with the human community, it sounds scary, doesn't it?

Opening up the possibility of using robots in the manufacturing sector is very beneficial. Today, robotics is a key driver of competitiveness in large manufacturing industries. In accordance with the times, schools should also surrender to the trends of the modern age and adapt to what is required. The introduction of robotics in schools would start the process of early education that meets the modern needs of the manufacturing sector. Thanks to early education, companies would not have to organize special training for employees because their employees would already be educated and in step with the technologies of the modern age.

CONCLUSION

Robotics has developed a lot in the last ten years. It is used in almost all aspects of life. The development of robotics within the framework of technology development requires an educational process that must be adapted in order to meet the ultimate goal, which is the competitiveness of the workforce. All the changes happening today are related to technology. As a society we must accept that technology can make our lives easier and that the development of technology is a positive side of the modern age. Changes in technology bring with them changes in the entire system, and the education system changes the most. Children are changing the world, and the demands of the labor market tell us every day about the lack of quality workforce. Especially those from the STEM field. The reason is the outdated education system, where teachers and professors themselves avoid using modern technology. Of course, there is a fear of modern, new, because modern and new brings with it both a number of advantages and a number of disadvantages. Children should be taught the positive sides of new technology, they should be taught how to use technology properly, because we still live in a time when the use of screens is really gaining momentum in the world. From birth,

children are exposed to screens, so this is another reason to present technology to children in the best light. The key to change lies in the teacher. They are the ones who should be the leaders of new ideas who should adapt to modern education. It takes a lot of effort and commitment, the education of the teaching staff of the older generations is very important. If we accept new teaching aids and aids, if we upgrade our own knowledge, we will achieve something. It is not the same now and 10 years ago. Today, a child knows how to use a mobile phone before he speaks, when he speaks he already uses one of the Internet platforms, he goes to school with very good computer skills. He explores modern technology, and the old education system is very boring for such a child. Change cannot happen overnight, but if we really want to, if we make an effort, we can do anything. We need to exhaust every atom of the development of science and technology, learn something new every day. Artificial intelligence, robotics, virtual reality, augmented reality, metaverse, 6G and a number of new technologies bring with them very big changes. For this reason, we have to change the whole system, starting with education. Enable the use of robots in kindergartens, schools, and workplaces. They are the ones who make everything easier for us, starting from home and household chores, to medicine, education. We have to change so that technology doesn't swallow us up. There is a quote that says, “If we don't change, we don't grow. If we are not growing, we are not living. (Gail Sheehy)"

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