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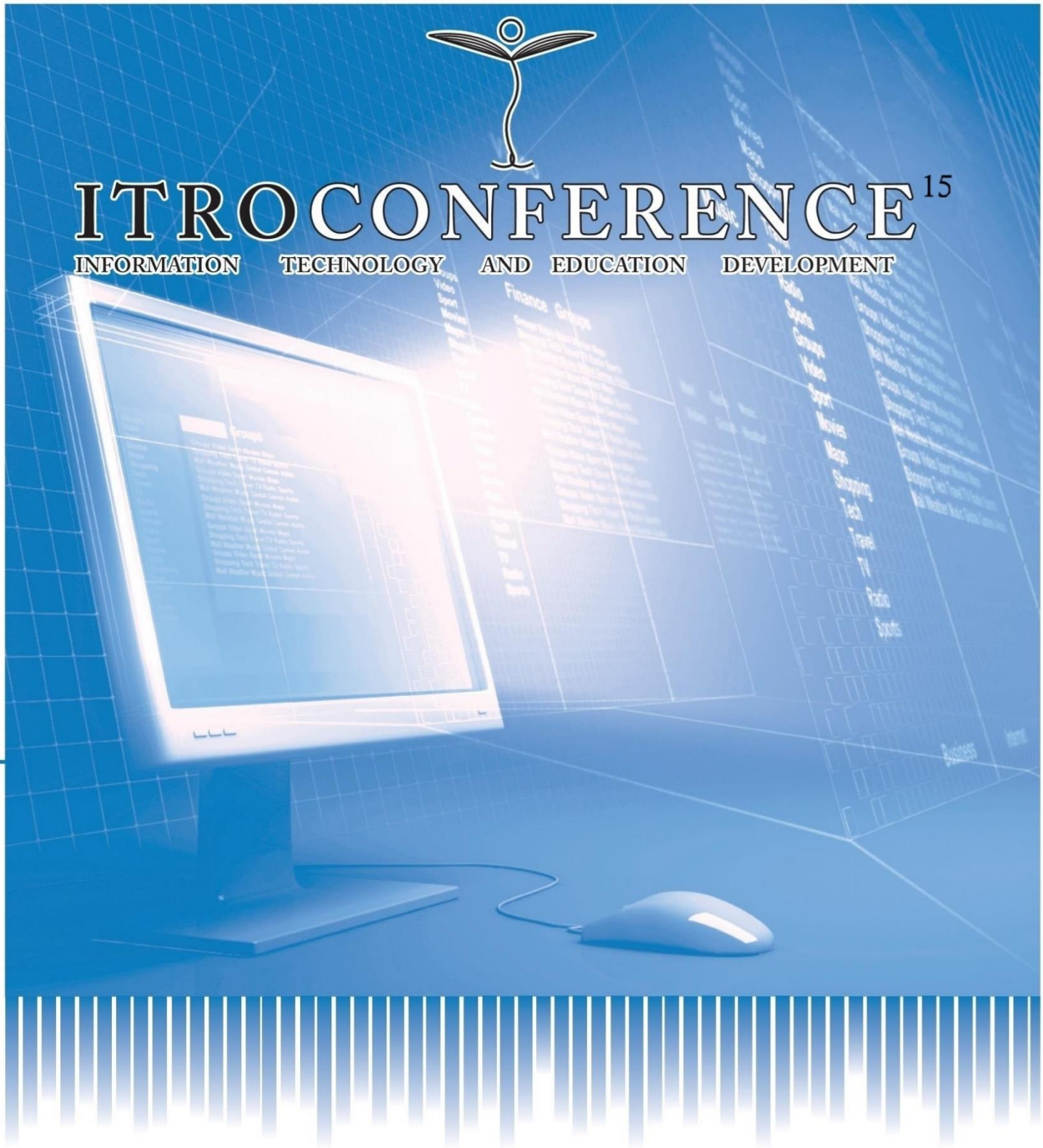

PROCEEDINGS

ZRENJANIN, November 2024

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PLENARY PAPERS

SCIENTIFIC PAPERS

Building Everyday and Basic Learning Skills through Play: Educational Robots as a Tool for the Improvement of the Learning of Students with Special Educational Needs

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Abstract. Educational robotics is used worldwide as a learning tool in education, but surprisingly rarely in special education. Education in the perspective of new technologies has opened new directions and orientations in the instructive-educational process.

Educational robotic tools, which can also be referred to as "robotic partners", are designed with the ability to adapt to different contexts depending on the circumstances. This is an important factor that makes robotic tools effective mediators for the inclusion of children with special educational needs (SEN) in educational programmes. Another important factor that supports this claim is the fact that educational robotics can promote learning through collaborative play with peers.

In this paper we will present part of our educational robot prototype and our expectations for its use in working with SEN students, also we will see the opinion of teachers for implementing robotics in their classes. The research for the teachers' opinion is done in Latvia, in one of our partner schools of the project.
This work is part of the research activities within the Robotics and Inclusion Erasmus + project.

Keywords and phrases: Educational robots, skills, interactive learning, progress, motivation

1 INTRODUCTION

Educational robots provide an individualised and interactive approach, creating a pleasant learning environment that motivates SEN students to develop their skills. Robots that incorporate educational activities in the area of basic learning skills, such as counting, drawing shapes, painting, directions and orientation, speed and spatial prepositions, help to improve the cognitive abilities of SEN students. In addition, activities that focus on the development of basic daily tasks, such as washing hands, going to the toilet, brushing teeth and tying up clothes, help to strengthen students' independence and autonomy in their daily lives. Educational robots also play an important role in developing emotional awareness through activities such as recognising emotions through colours and smiles, and helping students to understand and regulate their emotional states. This approach enhances both academic and life skills for students, allowing for better integration and progress in their school and social environments. In addition, the use of educational robots creates an opportunity to systematically measure student progress. By monitoring their learning and interactions with the robots, teachers can gather important data about students' skill development and progress, allowing them to tailor

instruction and provide additional support according to each student's individual needs. This analytical component of educational robots is crucial for optimising learning and achieving positive educational outcomes.

2 METODOLODY

This study employed a quantitative research approach using a structured questionnaire to collect data on the perceptions, experiences, and practices of educators and specialists regarding the use of educational robots in special education settings. The survey was designed to gain insight into the effectiveness of robotics in supporting students with special educational needs (SEN), the types of robots used, and the frequency of use in various subjects.

The target population for this study consisted of educators and specialists working with SEN students in Latvia. Participants were recruited from four types of institutions:

- Special education schools - development centers
- Special education schools
- General Education Schools providing inclusive education for students with special needs
- Pre- schools providing education for students with special needs

The data were collected through an online questionnaire that included of both closed and open-ended questions. The questionnaire was designed to gather information on:

- The type of institution in which the respondent worked in.
- The types of SEN students they worked with (e.g., intellectual impairments, autism, etc.).
- Their experience with using educational robots in the classroom.
- Their perceptions of the effectiveness of educational robots for SEN students.
- The types of robots used and the subjects in which these robots were incorporated.
- The frequency of robot use in different educational settings.

3 TEACHERS OPINION FOR USING ROBOTICS IN CLASROOM

A questionnaire to get some information about the use of educational robots in the special education in Latvia was created. The target audience of the survey was educators and other specialists who work with students with special needs. A total of 41 educators answers the question about using robotics in classroom.
The educators are teaching in Special education school-development center, Special education school, General education school providing inclusive education for students with special needs and Preschool providing education for students with special needs. In figure 1, a portions of working institution involved in the research are represented. The most of the answer of the questioner are from people that are working in special education school-development center. Most of the responders work with the students with mild and moderate intellectual impairments or severe or multiple impairments. The 49 % of the specialists work with the autistic students.

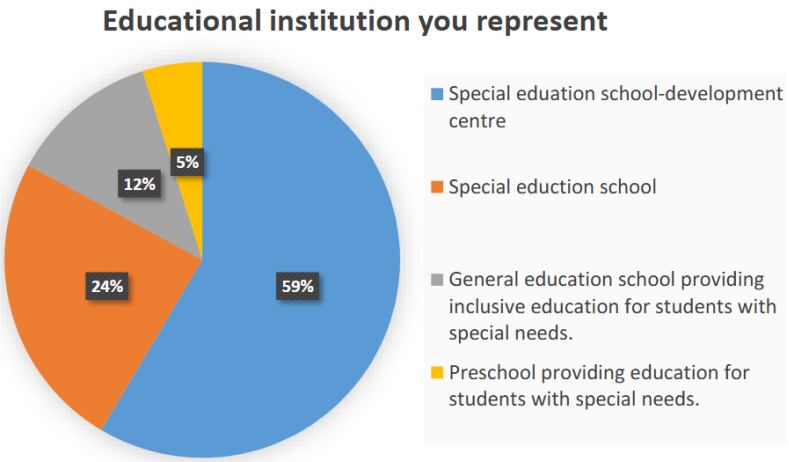

Figure 1. Involved educational institutions

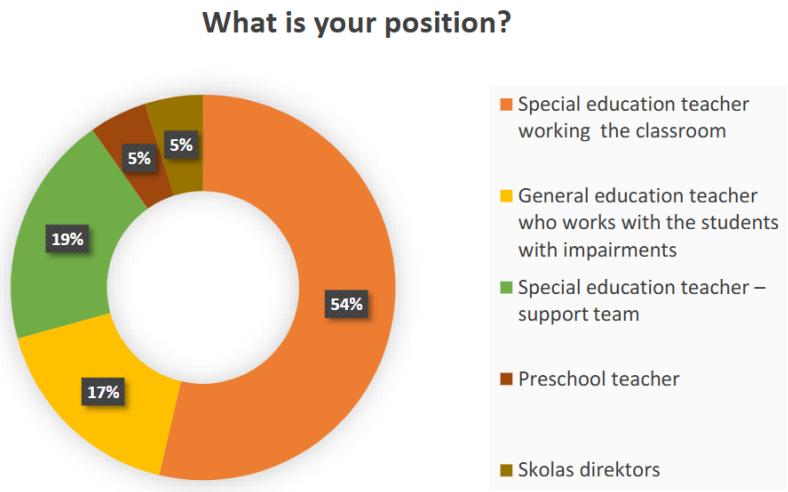

Figure 2. Job position

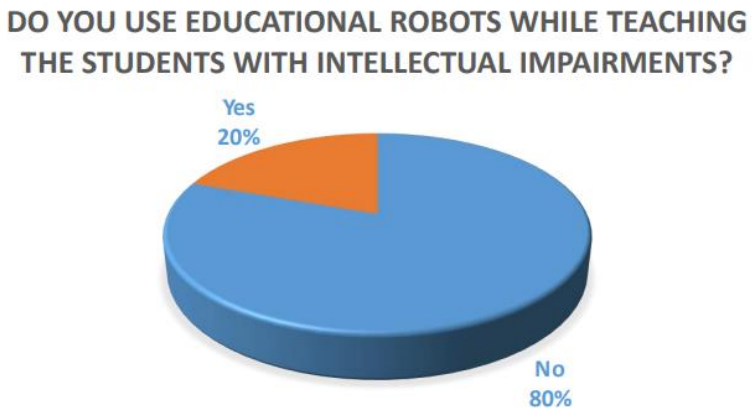

Figure 3. Usage of educational robotics for students with intellectual impairments

The 66 % of the surveyed specialists believe that the use of educational robots is useful and effective for students with special needs. The 10 % believe that the use of educational robots is not efficient and effective, the 24 % of specialists do not know or doubt this issue as is showed on figure 4.

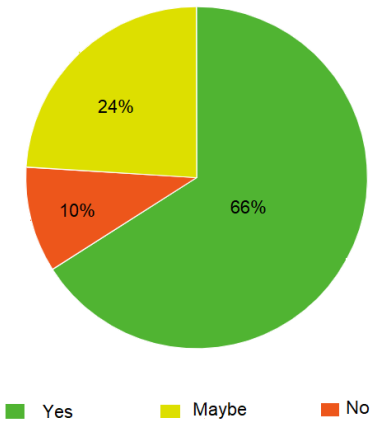

Figure 4. Impact of using education robots for students with special needs

Those specialists who work with educational robots use them more in design and technology, science, social studies, computing classes once a week or once per month. Most of the experts surveyed work with LEGO Education sets and TTS Bee-Bot robots.

The Bee-Bot is a programmable floor robot that looks like a bee and is designed for children ages three and up, to teach control, directional language and programming. The robot is colorful and easy to operate. The Bee-Bot moves in 15 cm increments and can store up to 200 directional commands at once. The Bee-Bot's movement can be programmed by pressing the directional arrows (forward, back, turn right 90 degrees, and turn left 90 degrees) in a sequence matching the desired movement and then pressing the green Go button. The robot blinks at the conclusion of each command to allow children to follow its progress through the program that they have entered. When the entire program is completed the robot confirms it with light and sound. This robot can be used in individual or collaborative settings (Bhattacharya, P. 2020).

LEGO® is a line of construction toys. They consist of different colored interlocking plastic bricks, accompanied by a whole range of different figurines, gears, and miscellaneous other elements. LEGO® has been used in various educational and therapeutic settings, mostly to foster social skills in children with autism (e.g., Huskens et al., 2015; Narzisi et al., 2021; Owens et al., 2008; Ramalho & Sarmento, 2019).

Special education and teaching tactics are necessary for children with special needs (SEN) due to their physical, mental, or social difficulties. In terms of behavioural, sociocognitive, and neurofunctional characteristics, they constitute a very diverse group. Sensory or motor impairments, autism spectrum disorders, mild to severe intellectual disabilities, specific neurodevelopmental disorders, such as attention deficit hyperactivity disorder (ADHD), specific learning disorders, specific language disorders, or other unidentified difficulties, are all possible diagnoses for children with special education needs (SEN). In order to address the deficiencies, social isolation, discrimination, and learning discrepancies of SEN learners, our initiative intends to incorporate robots into schools and centres.

In order to enable teachers working with kids who have special education needs in creating, implementing, and overseeing different techniques to promote robotics abilities in schools, the project intends to produce a comprehensive collection of tools and an instructional package. One effective, engaging, and inspiring approach to expose children incorporates subjects through robotics. Promotes other recruiting qualities at the same time, such initiative, creativity, teamwork, leadership, and problem-solving. Teachers and students will have international collaboration, cooperation, and communication options thanks to Educational Robots.

4 PROTOTYPE OF ROBOT WITH ARDUINO MICROCONTROLLER

The prototype robot is built using Arduino microcontrollers and has a 3D-printed body. Arduino acts as the 'brain' of the robot, controlling its functions and responses based on input from sensors.

The goal of the open-source Arduino microcontroller platform is to make the process of creating electronics projects easier. Its popularity in robotics is due to its ease of use, wealth of libraries, and large developer community that shares resources. Controlling robotic systems is made easy with Arduino boards, such as the Arduino Uno, which include multiple digital and analogue connectors to connect various sensors, motors, and components.

Arduino microcontrollers have inputs and outputs that can be used to obtain information, and based on the data received, Arduino can send output. Arduino microcontrollers can also send and receive data over the internet using HTTP requests. A simple microcontroller that can be connected to the internet is the Esp board. Esp microcontrollers can be connected to a Wi-Fi server or they can act as a Wi-Fi server (A.S. Ismailov, Z. B. Jo'rayev, 2022).

A common term for Arduino is the "brain" of the robot. This is so that the outputs to motors, lights, and other components can be controlled after the Arduino microcontrollers have processed the incoming signals from various sensors. The code - the "instructions" for the robot - determines how the device should respond to various inputs and perform tasks.

There are many different components involved in building a robot, but designing and building the robot's body is one of the most interesting. A 3D printer can be used to create a unique, robust, and useful structure for the body of the robot. In the robot that we will build at the end of the project, the body will be created using a 3D printer.

3D printing is an additive manufacturing (AM) process defined as "the process of joining materials to create objects from 3D model data, usually layer by layer, as opposed to subtractive manufacturing methods such as traditional machining" (Duda T & Raghavan, 2016;). 3D printing can deliver parts with very sophisticated

and complex geometries without the need for post-processing, built from custom materials and composites with almost no material waste, while being applicable to a variety of materials, including smart materials such as shape memory polymers and other stimulus-responsive materials. Therefore, 3D printing is a technology that offers increased "design freedom," allowing designers and engineers to create unique products that can be manufactured in low volumes in a cost-effective manner. One of the main examples of the design freedom offered is the ability to reassemble conventional assemblies into a single complex structure that could not be produced using current manufacturing processes (Gul, Jahan & Sajid, Memoon & Rehman, Muhammad & Siddiqui, Ghayas & Shah, Imran & Kim, Kyung-Hwan & Lee, Jae-Wook & Choi, Kyung, 2018).

On the front of the robot there will be a screen on which the students and teachers can select the functionality of the robot. The idea of the robot functionality is that the robot will have 3 different tasks. The first one will be to help the SEN students in basic daily activities. In this part, the robot will play an animation on the screen how the students can do certain activity. For example, the robot will play an animation how the students can wash their hands properly or put on clothes and some other daily activates.

In the second part of the functionality, the robot will teach the SEN students some basic mathematical concepts. For example, the robot will go on the road where there will be trees on both sides of the road, the task for the students will be to count how many trees the robot will pass. In this way, the SEN students will learn counting by trying the game with the robot.

Also the color sensor will be integrated in the robot, so when the robot sees a defined color it will make a torture. On this way the SEN students can learn the colors and also the orientation in the space left and right. Also with the orientation with the robot in the space, the SEN students will learn the basic geometric figure. For example, the robot will move and with the movement will draw a circle, on this way the students will know what movement with their hands they need to do to draw a circle.

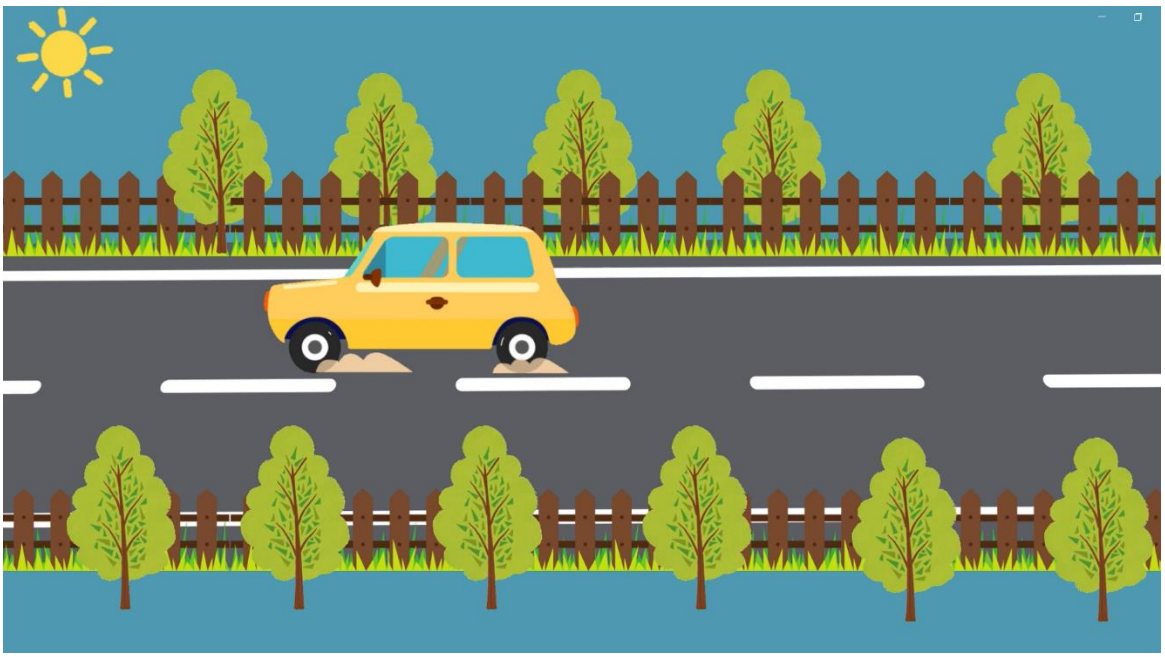

Figure 4. Animation for learn counting

For teachers working with SEN students, it is really important to know how they feel at a certain moment. So, in the third functionality of our robot, we are going to implement a question to the students about how you are feeling today. Students will be able to choose from pictures with emoji's that will be present on the screen. In this way, the teacher will always know the feeling of the students even if the student is not communicating with the teacher.

5 CONCLUSION

Educational robots play an important role in enhancing the learning experience of students, especially those with special educational needs (SEN). By providing interactive and hands-on activities, these robots encourage engagement with STEM subjects, while promoting essential life skills and emotional awareness. Feedback from educators in Latvia demonstrates a strong belief in the effectiveness of using robotics in the classroom, particularly for students with diverse learning needs. The prototype of the robot developed through the Erasmus project features innovative functionalities that support daily living skills, basic mathematical concepts and emotional expression, thus addressing the holistic development of SEN students. As the integration of technology in education continues to evolve, the implementation of such educational robots is poised to have a significant impact on student learning and progression.

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