# APPLICATION OF FLOOR ROBOTS IN SPECIAL EDUCATION INSTITUTIONS

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**Abstract**

This paper explores the introduction of robotics and coding into digital culture lessons in a Hungarian special education institution serving students with diverse special educational needs. As automation and smart technologies increasingly shape everyday life and future workplaces, schools must equip learners with transferable knowledge and adaptive skills. The study focuses on students with learning disabilities, whose cognitive, attention, and memory challenges often hinder traditional learning approaches. Although the national curriculum emphasizes digital competencies, robotics is not explicitly included. Based on classroom experience, the author integrates floor robots (e.g., Bee-Bot, Blue-Bot) to support algorithmic thinking through structured, scaffolded activities aligned with progressive developmental levels. Robot-based tasks enhance motivation and support decomposition, pattern recognition, abstraction, and step-by-step problem solving. Observations indicate improvements in spatial orientation, attention, collaboration, and problem-solving skills. The findings suggest that robotics offers an effective, engaging alternative to abstract programming tools and supports the development of essential 21st-century competencies in special education contexts.

**Keywords:** robotics education; special education; algorithmic thinking; digital culture curriculum; 21st-century skills

## 1. Introduction

For a long time, due to science fiction films, robots were thought to be something of the distant future. However, if we look around more carefully, we must realize that this distant future has already arrived. "Smart" objects and robots are gradually infiltrating our lives. Conferences speak of significant changes, as robots are expected to appear in workplaces. In many factories, production lines are already semi-automated, and in some places, machines work exclusively, supervised by a programmer. Sooner or later, this technology will spread to every part of industry. The role of schools is to prepare students for the future, and it seems that robotics is part of this process. According to László Mérő, the essence of education is acquiring good basic knowledge in a subject and developing the ability to transfer knowledge (Mérő, 2017). With this combination, students will be able to adapt to any new situation in the future.

## 2. Brief Introduction to the Special Education Institution

In the special education institution discussed in this paper, 159 students are enrolled in 19 groups. Among the students, there are those with learning disabilities, intellectual disabilities, autism spectrum disorder, and students with multiple disabilities.

I have been working in this institution since 2002, initially as a teacher, and later, after further training, as a special education teacher. In 2016, I passed the e-learning expert pedagogical professional exam. Over the nearly 23 years, I have carried out the work of almost every type of student group in the institution. Currently, I teach in classes for students with learning disabilities: mathematics to 5th and 6th graders, Hungarian language and literature to 5th graders, and digital culture to 3rd to 8th graders.

### 2.1. Characteristics of Students with Learning Disabilities

Students with learning disabilities exhibit persistent learning difficulties and learning impairments due to weaker functional abilities stemming from biological and/or genetic causes, as well as adverse environmental factors (Mesterházi, 1998). These students may exhibit difficulties in concentration, fine motor skills, complex cognitive processes, communication, spatial orientation, and concentration. Their working pace is slower, and they struggle with concentration. Memory performance decreases, making it difficult to recall learned information from long-term memory. Recognizing and applying analogies and connections is challenging. These symptoms appear in varying combinations and result in different degrees of developmental disorders in learning ability, preventing success in school learning (Mesterházi, 1998).

## 3. Curriculum Framework – Digital Culture Subject

In 2020, a new curriculum framework was introduced in a phased system. The previously predominantly theoretical subject of information technology was replaced by the new, multifaceted digital culture, aimed at developing applicable knowledge. The primary task of this subject is to prepare students for the challenges of the information society (Lénárd, 2020). The curriculum topics for the digital culture subject in primary schools include: the digital world around us, the use of digital tools, creation with digital tools, information gathering in the e-world, defense against the dangers of the digital world, and the basics of robotics and coding. The curriculum for students with special educational needs (SNI curriculum, 2020) defines the following topics within digital culture: the use of digital tools, application knowledge, problem-solving with digital tools and methods, information and communication, information society, and library techniques. Contrary to my expectations, neither the lower nor the upper primary school curriculum mentions robotics. I believe that the spread of robots will also affect the lives of our students. My experience shows that our students are also capable of learning to use basic robots. We have the necessary tools. Therefore, I find it necessary to introduce the basics of robotics and coding within the topic of problem-solving with digital tools and methods. This would have several positive outcomes, both for the students and the colleagues. On one hand, students would learn the basics of technology; on the other hand, their thinking would develop. Furthermore, by learning the sufficient use of the tool during digital culture lessons, colleagues would no longer have to deal with it and could easily use it in their own lessons.

### 3.1. Algorithmic Thinking

Algorithms are chains of elementary operations that are part of our everyday lives. From the moment we learn to button a coat to the point where we make a strudel according to grandma's secret recipe, algorithms bring structure and order to our lives. An algorithm is a sequence of operations that defines the solution method for tasks of the same type. When we use it, we are following a sequence of steps that leads to the solution of a given task or problem (Szántó, 2002).
There are four main components of algorithmic thinking, based on one approach:

- Decomposition: Breaking down a complex problem into smaller parts for easier resolution.
- Pattern recognition: Recognizing similarities between problems or between elements of problems, thus making it easier to solve similar tasks.
- Abstraction: Creating a solution model that considers only the essential elements.
- Algorithmization: Creating a step-by-step solution (Sarbó, 2017).

There are no sharp boundaries between these components; they are present in different lengths, simultaneously and interdependently, supporting each other.

## 4. Developing Algorithmic Thinking

The levels of algorithmic thinking have been structured into what are known as Algos (Lénárd, 2018). It is important to note that the progression through these levels is individual. Not every student needs to pass through every level.

- Algo1: Playing out a predefined algorithm. Between two points, without conditions.
- Algo2: Playing out a predefined algorithm. Between multiple points, with different conditions (touching, moving objects, avoiding obstacles).
- Algo3: Modifying an existing algorithm based on given conditions.
- Algo4: Creating a simple algorithm based on given conditions. Programming independently. Testing, analysis, possibly modification.
- Algo5: Creating a more complex algorithm based on given conditions. Programming independently. Testing, analysis, possibly modification.
- Algo6: Creating alternative algorithms. Designing and executing multiple solutions.
- Algo7: Creative algorithmization (e.g., programming a dancing bee).

The algorithms for these various levels can be played out in the following ways: using one's own body, laying out arrows, simulating with a Bee-Bot, and coding a Bee-Bot.

### 4.1. Tools for Development

Our institution has floor robots with simple coding capabilities. These robots can be controlled and programmed using buttons placed on their surfaces. They typically move through a maze or another track, proceeding step by step (DMPK, 2017). The following robots are available in our institution:

- Bee-Bot
- Blue-Bot
- Clementoni Mio
- Code & Go

These floor robots work in a similar manner: they are controlled by buttons on their backs. They memorize the sequence of steps programmed into them, so before each new task, the previous sequence must be erased. They are capable of moving forward and backward, as well as turning 90 degrees left or right. They also have a pause and reset button. The difference between them lies in the distance they move forward and backward, which is 15 and 12.5 centimeters, respectively.
For the sessions, we also need so-called tracks. These are materials with a grid pattern on which pictures, objects, or text can be placed according to the task. The size of the squares that form the grid depends on the movement distance of the robot.

### 4.2. Developing Algorithmic Thinking within the Digital Culture Subject

During the study of digital culture, the development of various skills is the task, including attention, memory, and auditory perception. In addition to functional abilities, mathematical and cognitive competencies, such as problem-solving and algorithmization, also need to be developed. For the latter, the curriculum suggests using turtle graphics at the upper primary school level. We have used this program in previous years. Its use, however, did not generate the expected motivation. Remembering the basic commands was not an issue. However, when these were to be used to create shapes, problems arose. Few students could draw a shape independently. Even typing the commands posed a challenge, as they struggled with attention, using too few or too many spaces, thus ruining the task. This program is too abstract for their thinking. I can say that this is not a favored activity during class.

However, algorithmic thinking can be developed using another tool: the robot. Since I have already used this tool and compared it with turtle graphics, I have observed that students are much more eager to work with it, and its handling is much simpler. They learn it much faster than the basic commands of the Logo language.

My goal is to develop the skills and abilities foreseen in the curriculum through the introduction of the basics of robotics and coding. Among others, algorithmic thinking. Since students with learning disabilities often have impaired thinking processes, algorithms can serve as a scaffold for them. They can learn that there are well-established procedures for solving problems in everyday life. The levels of algorithmic thinking development have different phases. My first task was to identify these levels with the help of literature. I have arranged these phases according to difficulty. I have also associated task types with these levels.

Before trying out the tasks, the students perform a simple paper-pencil entry measurement to check if they are familiar with directions, and they must also draw a route on a grid surface. Only after this does the actual work begin. During the completion of the levels, observation is necessary, as previous experience shows that students in a class do not all possess the same basic abilities. Some complete the tasks more quickly and efficiently. This also allows for differentiation. Observation criteria include how well a student has mastered a particular task type and who succeeded and who did not. It is also recorded how much time it takes to master a given task. These observations determine the pace of further progress.

When learning to use floor robots, I typically apply the following order of difficulty:

- **Playing out an algorithm**:
  Here, the children themselves become the robots. I create a track on the floor for them. The instructions for the task can be given in several ways:
  - Children guide each other verbally or by touch.
  - Following a sequence of signs after learning the direction indicators.
  - Designing their own route after identifying the destination.
- **Executing a predefined algorithm with the robot**:
  At this level, they become familiar with the properties and operation of the tools. On a prepared track, we determine the starting point together. Each student draws a card with predetermined directions. The student programs the robot with the sequence of steps and then starts the robot. The key question here is: Where did the robot end up?
- **Creating an independent algorithm for a simpler problem**:
  This task type is divided into two parts. Initially, they solve a task where the robot can only move forward and backward without turning. Later, the robot can perform full movement. They receive instructions either verbally or in writing. If remembering the steps is difficult for some, they can lay out arrows or, step by step, hold the robot and simulate the movement.
- **Creating an independent algorithm for a more complex problem**:
  In this task, the complexity comes from needing to guide the robot to multiple targets, or there may be squares where the robot is not allowed to pass. If remembering the steps is challenging for some, like in the previous type, they can lay out arrows or simulate the movement step by step while holding the robot.
- **Using a ready or self-created algorithm for a simpler problem on a flat paper grid**:
  According to our experience, this is currently the most difficult task type. The difficulty may stem from the abstraction required for the problem. For navigating the grid, small figurines or caps may help. They either need to follow a prewritten algorithm or create their own and describe it using symbols.

## 5. Experiences

The use of robots is versatile and can be applied in any type of class, lesson segment, or work form. It provides opportunities for differentiation. The possibilities for tasks are endless. The tool has a significant motivational power, and students are eager to work with it. In addition to algorithmic skills, it also helps develop spatial orientation, attention, thinking abilities, creativity, problem-solving thinking, and reading comprehension. In the early lessons, the difference in language usage between spoken language and "robot language" often posed a problem. In our language, the expressions "going right" or "left" refer to a step during a turn. In "robot language," the same expression only refers to the turning action, without the step. This semantic difference must be highlighted. The experiences show that this is an incredibly useful and motivating tool; however, like anything else, its use should not be overdone. The goal should determine the tool, not the other way around.

## 6. Conclusions

During the introduction of the basics of robotics and coding, I have gathered experiences. In my opinion, the introduction of floor robots in the education of students with learning disabilities is justified and necessary, not only in the digital culture subject.
The sequence in which students learn to use floor robots is ideal for our students. The pace of progress depends on the abilities of the specific class and individual students. The use of floor robots appropriately replaces the Imagine Logo program. I believe that these tools should be used at any level, even in other subjects.
The initial plan was for the students to master all levels by the third grade. We have one digital culture class per week, and the desired number of hours would take time away from other important topics. Therefore, I decided to spread this amount over two grade levels.
The curriculum also includes the topic of problem-solving with digital tools and methods in the upper grade levels (SNI curriculum, 2020). The floor robots available to me are no longer motivating for this age group. Therefore, other tools and applications will be needed here.
While using floor robots, students develop many skills, including what are referred to as 21st-century skills, such as creativity, communication, collaboration, ICT use, knowledge building, learning techniques, self-regulation, critical thinking, problem-solving, and, last but not least, algorithmic thinking (Fegyverneki, 2018). The development of all of these skills can contribute to the success of our students in the uncertain labor market of the future.

## References


1. Mérő László (2017): Konvertálható tudás in: Gondolkodni -más- hogy? Tanulmányok a gondolatfejlesztés lehetőségeiről kisgyermekkorban edited by Eszterág Ildikó, Lehmann Miklós pp: 9-24 Download: https://www.tok.elte.hu/media/8c/99/31e54eba947896bd3533e2ef080f32d2f0414ab66777e773c01a59bd898a/GMH1_kotet.pdf (Accessed: 2025.05.25.)
2. Mesterházi Zsuzsa (1998): A nehezen tanuló gyermekek iskolai nevelése Lénárd András (2020): VIII. Digitális kultúra Download: https://www.oktatas2030.hu/wp-content/uploads/2020/05/nat-2020-lnrd-andrs-digitlis-kultra-tant-20205-6..pdf (Accessed: 2025. 05. 24.)
3. Szántó Sándor (2002): Algoritmikus gondolkodás fejlesztése az általános iskolában. Download: https://folyoiratok.oh.gov.hu/uj-pedagogiai-szemle/az-algoritmikus-gondolkodas-fejlesztese-altalanos-iskolaban (Accessed: 2025.05.25.)

4. Sarbó Gyöngyi: A kódolás szerepe az algoritmikus gondolkodásban kisiskolás korban in: Gondolkodni -más- hogy? Tanulmányok a gondolatfejlesztés lehetőségeiről kisgyermekkorban edited by Eszterág Ildikó, Lehmann Miklós pp: 60-79 Download:https://www.tok.elte.hu/media/8c/99/31e54eba947896bd3533e2ef080f32d2f0414ab66777e773c01a59bd898a/GMH1_kotet.pdf (Accessed: 2025.05.25.)
5. Lénárd (2018): Az algoritmikus gondolkodás fejlesztése padlórobotok segítségével edited by Dr. Lénárd András.
6. Fegyverneki Gergő (2018): Játék, munka, tanulás A 21. századi projektmódszer kézikönyve pedagógusoknak.
7. Oktatási Hivatal. (2020). Kerettanterv az általános iskola 1–4. évfolyamára (Nat 2020). Retrieved May 24, 2025, from https://www.oktatas.hu/kozneveles/kerettantervek/2020_nat/kerettanterv_alt_isk_1_4_evf .
8. Oktatási Hivatal. (2020). Kerettantervek sajátos nevelési igényű tanulók számára. Retrieved May 24, 2025, from https://www.oktatas.hu/kozneveles/kerettantervek/2020_nat/kerettantervek_sni_tanulok.
9. Bontovics, I. (n.d.). Bee-Bot robot. Interaktív elemi matematikai feladatok óvodapedagógusoknak. Retrieved May 25, 2025, from:http://www.jgypk.hu/mentorhalo/tananyag/Interaktv_elemi_matematikai_feladatok_vodapedaggusoknak/beebot_robot.html.
10. Dunaújvárosi Pedagógiai Oktatási Központ. (2017). Problémamegoldás az alsó tagozaton Bee-Bot/Blue-Bot robotokkal. Retrieved May 25, 2025, from https://dpmk.hu/2017/11/29/problemamegoldas-az-also-tagozaton-bee-botblue-bot-robotokkal/.