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The Effects of RIDE and RIDEX on 8-12-year-old children

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*It is also based on **focus group interviews with teachers** participating in the RIDEX project in 2023 and 2024.*

This impact evaluation report presents the findings of our two+two-year study examining the impact of the RIDE-RIDEX educational robotics intervention on primary school students' text comprehension, computational thinking, creativity, language skills, spatial orientation, visio-constructive ability, attention and social skills. The study was conducted in the RIDE project across six schools in Hungary, Spain, Romania, and Italy (two of them were special schools) and in the RIDEX project across five schools in Hungary, Romania, Austria and Turkey, using a pretest- posttest quasi-experimental design with 200 participants.
Findings indicate a significant improvement in creativity, particularly in figural creativity and integrative thinking, reading accuracy, text comprehension in the mother tongue as well as in second language, and visuo-construction skills among students in the experimental group.
Additionally, computational thinking, spatial orientation, language communication and partly attention showed positive growth over time, though this increase was not significantly greater in the intervention group compared to the control group.

We also measured attitudes toward science and robotics, as well as SEL competencies, but we were unable to detect significant changes in these areas due to the intervention using the measurement tools employed. On the other hand, according to the observations of the teachers participating in the intervention, the children's cooperation skills, teamwork, argumentation and consensus-building skills improved significantly as a result of the intervention.

These results suggest that educational robotics can effectively support several skills development, but additional pedagogical strategies may be needed to maximize its impact on computational thinking, social skills and broader learning outcomes. Future developments are planned to explore structured approaches to these outcomes in classroom settings.

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Summary of the RIDEX project's measurable impact , 2025.

Computational Thinking, Creativity, Social-emotional Learning, Science attitude
RIDEX, 2022-24. ELTE *Faculty of Education and Psychology*

1. Methods

1.1. Design

This study employs a longitudinal pretest-posttest quasi experimental research design, tracking changes in students' cognitive and affective development over the course of one academic year. The study was conducted across four schools in Hungary, Romania, and Turkey divided into experimental and control groups. Students in the experimental group participated in the RIDEX robotics curriculum, which incorporated digital storytelling and collaborative problem-solving exercises, while students in the control group followed the standard school curriculum without additional robotics activities.

1.2. Participants

A total of 128 students (M age = 12.04, SD = 0.92) from Hungary, Romania, and Turkey participated in the study. The sample included 60 students in the intervention group and 68 in the control group. N=128, aged 11-14 years (M=12.04, SD=.91), from four schools, consisting of 65 boys and 58 girls, with 77 fifth-grade and 47 sixth-grade students.

1.3. Instruments

Computational Thinking Test. To measure the developmental effects of the interventions on students' computational thinking a form of the Bebras measurement tool was used (Dagiené & Stupuriené, 2016). It is an age appropriate and attractive measurement tool that consists of 12 exercises including tasks that measure different levels of computational thinking (understanding and applying, analyzing, evaluating and creating). To solve the tasks thinking skills that are used in computer science are required, but previous knowledge in that field is not a necessity (Pluhár, 2021). Children had 45 minutes to complete the test. A different version of the measurement tool was used for the pretesting (Cronbach-α = .65) and posttesting (Cronbach-α = .72).

Creative Thinking Test. To assess creativity, the Evaluation of Potential Creativity (EPoC) test (Barbot et al., 2016) was administered. The EPoC is a widely recognized instrument designed to measure figural and verbal creativity by distinguishing between two key cognitive processes: divergent-exploratory thinking and convergent-integrative thinking. Divergent-exploratory thinking refers to the ability to generate multiple, original ideas from a given stimulus, while convergent-integrative thinking involves synthesizing various elements into a single, cohesive, and innovative solution. The test consists of two parallel versions, A and B, to ensure reliability and comparability over time. Version A was used as the pretest, and Version B was administered as the posttest. The assessment includes eight tasks divided into figural and verbal domains. Figural creativity tasks required students to engage in visual-based exercises, such as transforming abstract shapes, completing unfinished drawings, and designing visual narratives. Verbal creativity tasks involved story completions, title generation, and character development, allowing students to demonstrate creative storytelling abilities. The test was conducted individually, with students using pencils, erasers, and colored markers for completion.

Science Attitudes Scale. To measure students' attitudes toward science the Short Robotics and Science Attitude Survey (Cunningham & Lachapelle, 2010) was used. The same paper-based questionnaire was administered to students during both the pretesting (Cronbach-α = .81) and posttesting (Cronbach-α = .82) period. The scale uses 19 items with 5-point Likert-scale questions. The items assess students' attitudes towards the relevance of science to real life, jobs and helping society; their attitudes towards scientists; and their attitudes towards scientific thinking, particularly invention and „figuring things out" (Cunningham & Lachapelle, 2010).

SEL Competencies Scale. Based on the CASEL theoretical model, the questionnaire consists of 27 items with 5-point Likert-scale (Ross & Tolan, 2018). Two of the five dimensions of the model were measured: social awareness, relationship building: relationship building skills and the quality of the relationship. (Cronbach-α: pretest = .86, posttest = .89).

1.4. Procedures

Students participated in weekly robotics sessions over one academic year. Both groups completed pretests at the beginning and posttests at the end of the study.

1.5. Data Analysis

Repeated measures ANOVA was used to assess within-group and between-group differences over time. Assumption were checked and met.

2. Results

2.1. Computational thinking

The results of the CT Test revealed a main effect of time, indicating improvement across both the experimental and control groups. However, no statistically significant difference was found between the two groups in terms of development over time, $F(1,121) = 0.323$, $p = .57$. Table 1 presents the descriptive statistics for the CT test scores,.

Table 1. Descriptive Statistics for Computational Thinking (Bebras Test Scores)

Measurement Time	*Control Group* *M (SD)*	*Experimental Group* *M (SD)*
Pretest	3.16 (2.17)	3.05 (1.83)
Posttest	4.91 (3.32)	4.48 (2.38)

Note: Bebras test score range = 1–12; $n_{control}$= 67, $n_{experimental}$= 56.

2.2. Creativity

The results indicate a significant improvement in overall creativity among students in the experimental group compared to the control group, $F(1,125) = 6.35$, $p = .01$, $\eta p^2 = .05$. This suggests that participation in the RIDEX intervention had a positive effect on students' creative

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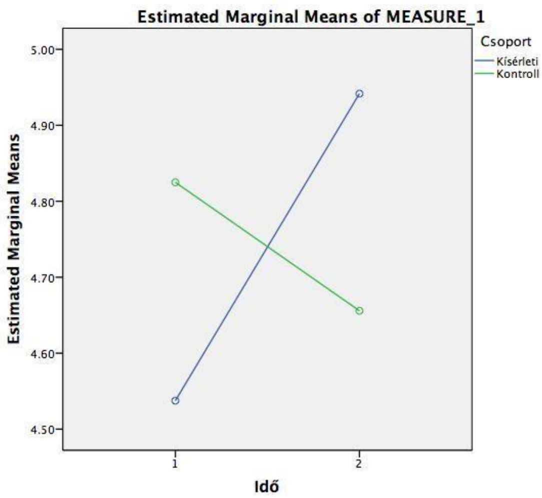
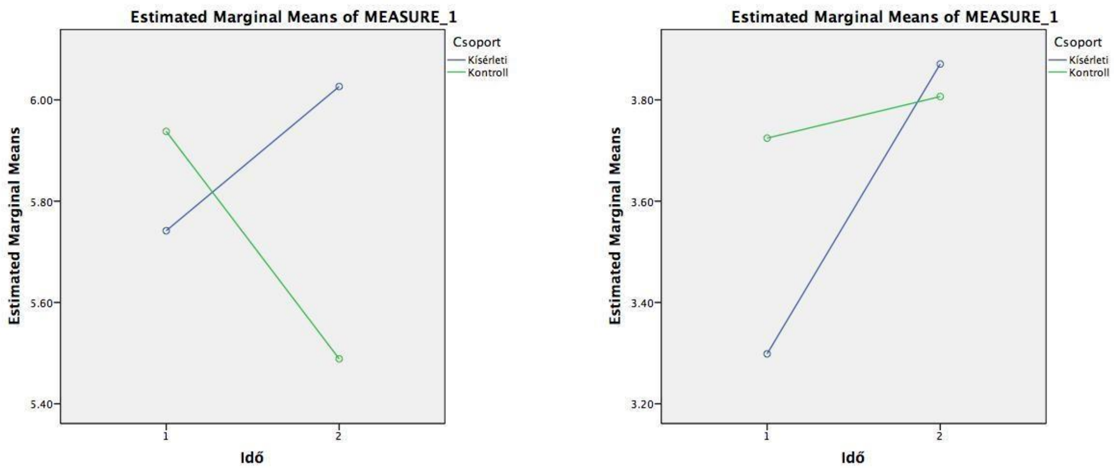
thinking skills. Refer to Figure 1 for the effects of RIDEX on the overall creative thinking score.

Figure 1. The Impact of RIDEX on Overall Creative Thinking Scores



For figural creativity, a significant improvement was observed in the experimental group, F(1,125) = 8.52, p = .02, ηp^2 = .05. However, there was no significant improvement in verbal creativity, F(1,125) = 0.668, p = .09, ηp^2 = .02, indicating that the intervention did not enhance students' verbal creative abilities. Refer to Figure 2 for the effects of RIDEX on figural and verbal creative thinking scores.

Figure 2. The Impact of RIDEX on Figural and Verbal Creative Thinking Scores



Regarding divergent creativity, no statistically significant improvement was detected in the experimental group, F(1,125) = 2.13, p = .14, ηp^2 = .02. In contrast, integrative creativity showed a significant improvement, F(1,125) = 9.50, p = .003, ηp^2 = .07, suggesting that students in the RIDEX program developed better abilities to synthesize and integrate creative ideas. Refer to Figure 3 for the effects of RIDEX on figural and verbal creative thinking scores.

For the descriptive statistics of creative thinking scores, see Table 2.

Figure 3. The Impact of RIDEX on Divergent and Integrative Creative Thinking Scores

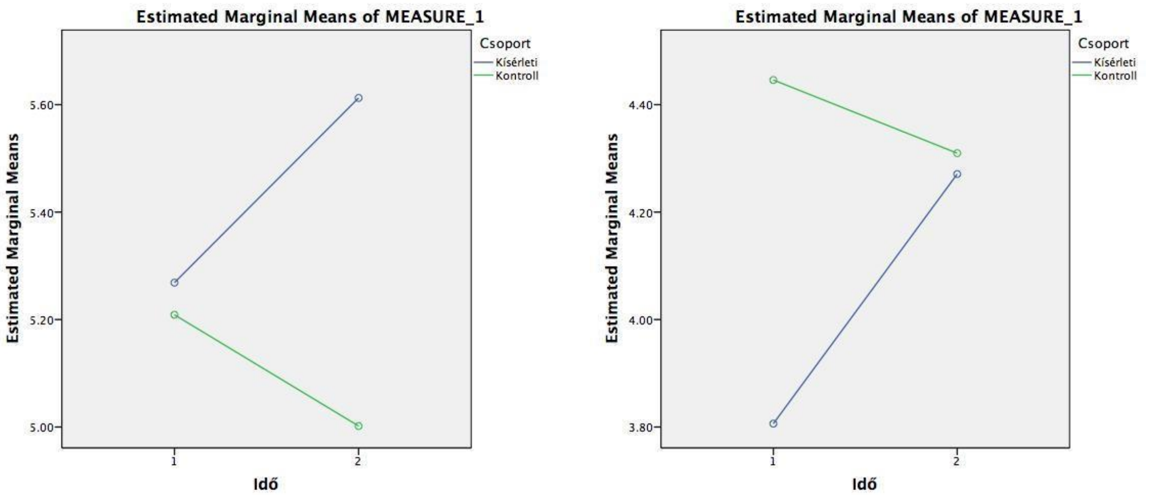


Table 2. Descriptive Statistics for Creative Thinking Scores

Creativity Measure	*Time Point*	*Experimental Group M (SD)*	*Control Group M (SD)*
Overall Creative Thinking	Pretest	4.53 (1.31)	4.94 (1.65)
	Posttest	4.83 (1.44)	4.65 (1.50)
Figural Creativity	Pretest	5.74 (2.09)	5.94 (1.95)
	Posttest	6.02 (2.10)	5.48 (2.03)
Verbal Creativity	Pretest	3.30 (1.26)	3.74 (1.50)
	Posttest	3.87 (1.61)	3.80 (1.53)
Divergent Creativity	Pretest	5.27 (2.24)	5.21 (2.28)
	Posttest	5.61 (2.81)	5.00 (2.33)
Integrative Creativity	Pretest	3.81 (1.06)	4.45 (1.19)
	Posttest	4.27 (1.23)	4.31 (1.05)

Note: Scores range from 1 to 7. $n_{experimental}$= 60, $n_{control}$= 67.

2.3. Social Emotional Learning

The results of the Social-Emotional Learning (SEL) scale indicated a main effect of time, suggesting that SEL scores declined over the study period in both the experimental and control groups. However, no significant difference was observed between the groups (Time: $F = 3.288$, $p = .72$; Group: $F = 0.247$, $p = .620$). This suggests that while SEL competencies changed over time, the RIDEX intervention did not prevent the observed downward trend compared to the control group.

Table 4. Descriptive Statistics for Social-Emotional Learning (SEL) Scores

Measurement Time	*Control Group M (SD)*	*Experimental Group M (SD)*

Pretest	3.7 (0.72)	3.8 (0.67)
Posttest	3.6 (0.83)	3.7 (0.64)

Note: $n_{control}$= 62, $n_{experimental}$ = 58.

3. Discussion

The results indicate that while students showed growth in computational thinking over time, the RIDEX intervention did not lead to significant improvements beyond natural development. Specifically, students in both the experimental and control groups demonstrated an increase in computational thinking, but this improvement was not significantly greater in the intervention group. This suggests that general classroom exposure to problem-solving tasks may have contributed to their development. Additionally, the findings align with previous research indicating that educational robotics interventions may require extended engagement or structured pedagogical approaches to yield significant gains in computational reasoning (Fanchamps et al., 2021; Ioannou & Makridou, 2018In addition, We analyzed the professional profiles of teachers implementing the RIDEX project modules with students and found that in the vast majority of cases, they were not IT specialists, but rather teachers of native and foreign languages, which may have influenced the intensity and effectiveness of intervention specifically in the areas of CT, programming, and robotics.

A key finding of this study is the significant improvement in creativity among students in the experimental group, particularly in figural creativity and integrative thinking. These results support the notion that robotics-based learning environments can foster creative thinking by encouraging exploration, problem-solving, and synthesis of ideas (Zhou et al., 2022; Hu et al., 2023). However, verbal creativity and divergent thinking did not show significant gains, suggesting that additional instructional strategies may be necessary to strengthen these dimensions of creativity.

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Language skills
RIDEX, 2022-24, Ágnes Jordanidisz

Bilingualism can be approached from many different angles. In the past, there was a more maximalist view that bilingual people or bilingualism meant that someone spoke two languages at the same level, i.e. at the level of a native speaker. This was balanced bilingualism.

Today, a functional approach prevails, according to which a person can be bilingual if they have a mother tongue and then, during their lifetime, acquire one or more languages in which they can communicate with people who speak those languages.

Bilingualism can be viewed in terms of cognitive organization.

A child grows up with one mother tongue and learns another language at school, which they become increasingly proficient in, but these two languages remain separate entities.

Complex bilingualism occurs when a child grows up in a truly bilingual environment and in a bilingual family, and both languages form a single entity in the nervous system.

According to the time sequence, we distinguish between simultaneous and consecutive bilingualism. A child is simultaneously bilingual when they grow up in a truly bilingual environment and begin to speak. Consecutive bilingualism is when a child learns two or more languages one after the other.

What was particularly important from our point of view was how the relationship between the two languages develops according to social status.

We speak of additive bilingualism when both languages have a sufficiently high social status. The child speaks both languages willingly and considers it important to use them, e.g. to preserve a minority language.

We speak of interchangeable bilingualism when speakers of a minority language want to fit into the majority language society and sooner or later their mother tongue dies out because they do not pass it on to their children. We find examples of both in the project countries.

Let's take a look at the language environment in the participating schools. In the RIDEX project, we worked with bilingual schools and defined the target language for each school, which we aimed to strengthen through robotics classes.

Our goal was to develop reading comprehension, linguistic creativity, and language awareness. This was the novelty of RIDEX compared to the previous RIDE project.

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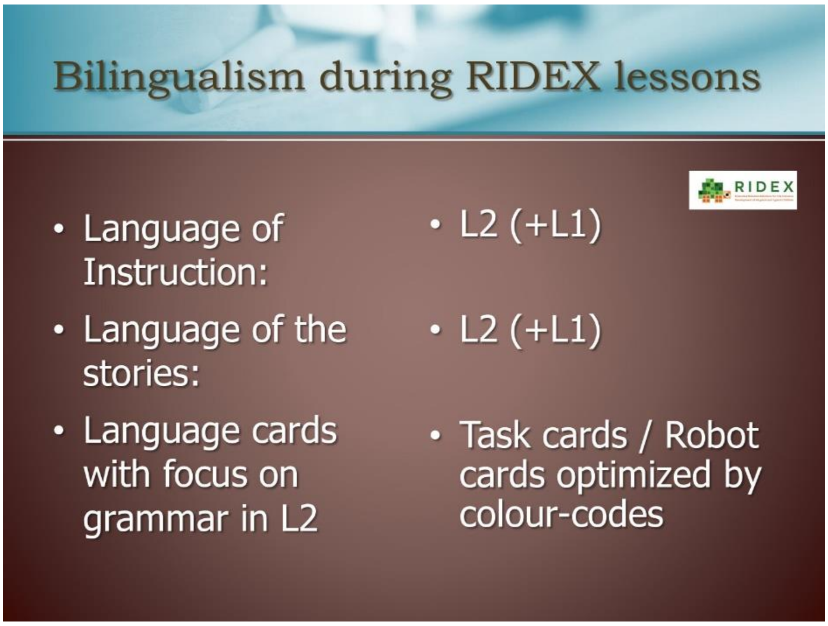
Florya (TR) The official language of instruction was the official language of the country and the mother tongue of the majority of the children (Turkish), while the target language was English.

Kölcsey (RO) The mother tongue of the students and the language of instruction at school was the minority language (Hungarian), and the target language was the official language of the country (Romanian).

Slovak (HU) The mother tongue of the students and the language of instruction at school was the minority language (Slovak), and the target language was also the minority language (Slovak).

Laimacker (AT) The children had very different minority mother tongues because the children of immigrant families in Austria participated in this project. Here, the target language was the official language of the country (German).



It was not possible to compare different countries, as their levels of comfort are completely different. So we examined the children's development relative to themselves. We had an initial assessment, an assessment after one year, and a final assessment after two years. The text was the same for the initial assessment and the assessment after two years.

The reading comprehension tasks and questions in this test were based on the Blum taxonomy and were at the comprehension, application, and recall levels.

Results

Briefly about the results. After one year, those who participated in the development performed slightly better, though not significantly, on the language and reading comprehension tests than the control group.

The results also show that in the second year, when we introduced the language robot cards, the results of the experimental group improved significantly, so we can really see the effect and that the language tools built into the program help target language development.

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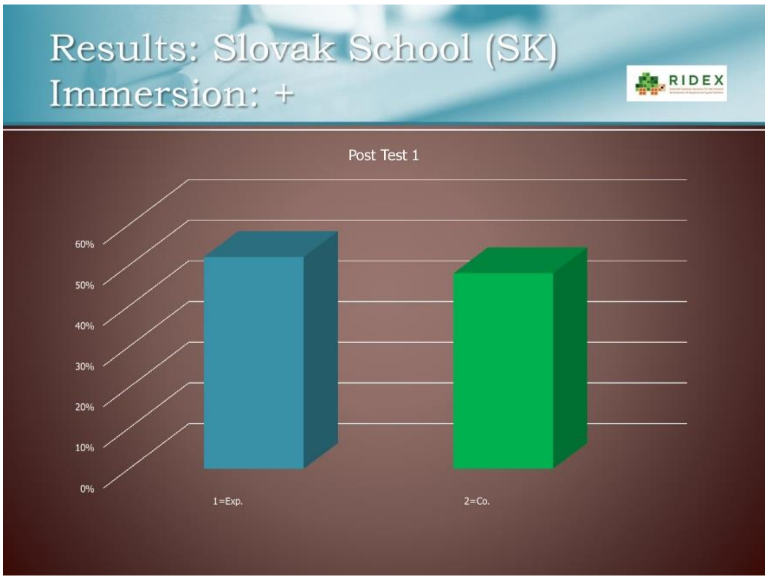

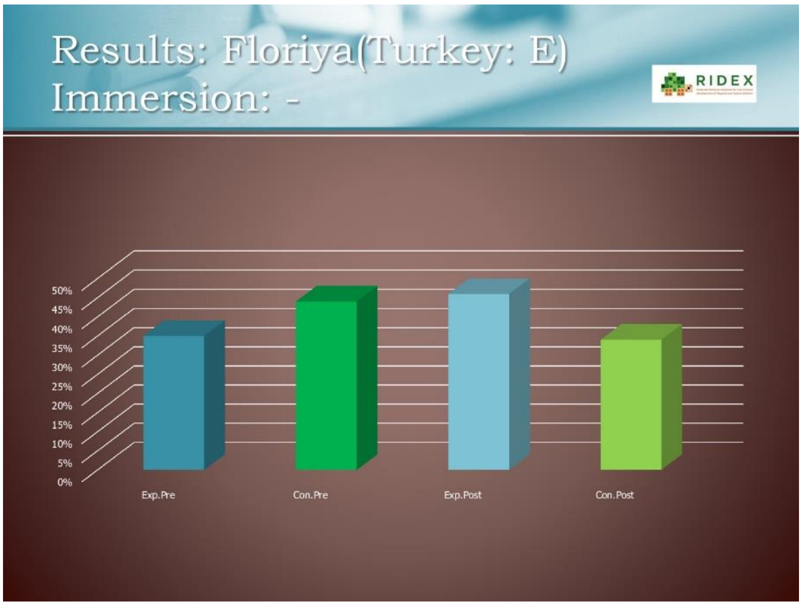

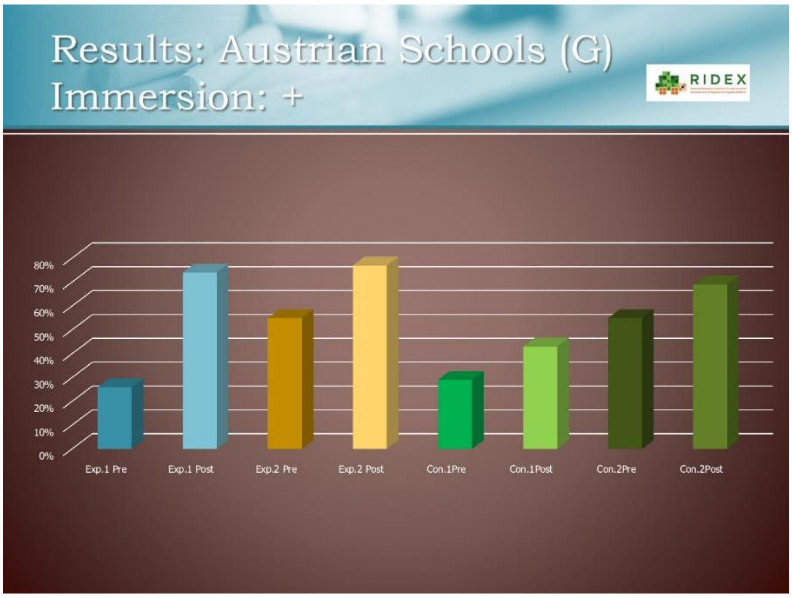

What we experienced in Austria can be highlighted as a very significant achievement. Immigrant children who knew practically no German were able to understand and process the text at a native level by the end of the year.

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Summary of the RIDE project's measurable impact , 2022.

Katalin Mohai, Csilla Kálózi-Szabó, Demis Basso, Alessandro Colombi

The main objective of the RIDE project was to build a sustainable bridge between the worlds of technology and education, while assuring the development of self-regulated learning and taking into account learners' neurodiversity. To detect how the robotics can contribute to the development of different fields we tried to assess the measurable changes obtained by processing the text with robotics. The following areas were investigated: reading and text comprehension, visio-constructive ability, attention, spatial orientation, CT.

Means (and standard deviations) for each measure and differences between Pre-test and Post-test.

Variables	Pre-test *M* (*SD*)	Post-test *M* (*SD*)	*t*	df	*p*	Cohen's *d*
Beaver cards						
Scores	14.18 (15.20)	17.71 (15.47)	–1.021	20	0.319	–0.223
WJSR Test						
Spatial Relation Test	19.82 (3.62)	21.29 (3.51)	–1.751	20	0.095	–0.382
DWSM						
Cross points	7.86 (1.21)	7.90 (1.41)	–0.404	20	0.691	–0.088
Cross time (in sec)	15.37 (4.33)	10.86 (3.75)	5.031	20	0.000	1.098
Clock points	9.73 (2.96)	10.19 (2.87)	–0.140	20	0.890	–0.031
Clock time (in sec.)	87.39 (57.62)	70.38 (27.20)	0.999	20	0.330	0.218
Bell Test						
Accurate responses	97.55 (12.48)	97.17 (21.99)	0.164	15	0.872	0.041
Reading comprehension Test						
Reading time (in sec)	298.47 (79.	276.37 (32.	1.228	9	0.251	0.388

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	39)	16)				
Reading errors	17.07 (12.51)	14.62 (8.30)	3.115	9	0.012	0.985
Reading comprehension accurate responses	2.50 (1.35)	4.37 (1.31)	–2.177	9	0.057	–0.688
Reading comprehension inaccurate responses	1.57 (1.02)	0.25 (0.45)	3.881	9	0.004	1.227

As it can be seen in the table the pre-test/post-test results showed significant improvements in several areas: in particular, there were significant changes in reading accuracy, text comprehension and visuo-construction skills. We suppose that this result can be attributed to the fact that the children were more motivated to process the texts in depth because of the robotics. During the project work, according to their individual needs they could work with several types of texts, and the processing was also supported by tasks and worksheets related to the text. According to teachers' feedback, there have also been cases when a child's curiosity was so aroused by a particular text that he or she read the literary work in its entirety. The improvement of the execution time in the visuo-constructive ability and the tendentious improvement in the spatial orientation skills (WJ - Spatial relations) can be explained by the specificity of ArTec robots (the building blocks have no top and bottom and can be rotated in any direction), because the construction itself strongly uses these skills. In all other measures there were no significant differences between pre- and post-test, although the results suggest a general improvement in nearly all remaining measures, with the exception of the selective and focused attention (Bell) test. Interpreting the results, we should also take into account the fact that the original development plan of 10 modules was replaced by only 5 modules due to the pandemic situation. It is conceivable that, if the modules had been scheduled as originally conceived, the results would have been different from those obtained in the present study.

The experience of this research offers promising opportunities for developing the cognitive and socioemotional skills of children with special education needs (**SEN**) in inclusive groups. This pilot study could form the basis for further impact studies with ArTec robots.