Impact of Robotic Programming Environments on Computational Thinking with an Effect on Word Reading Fluency and Decoding

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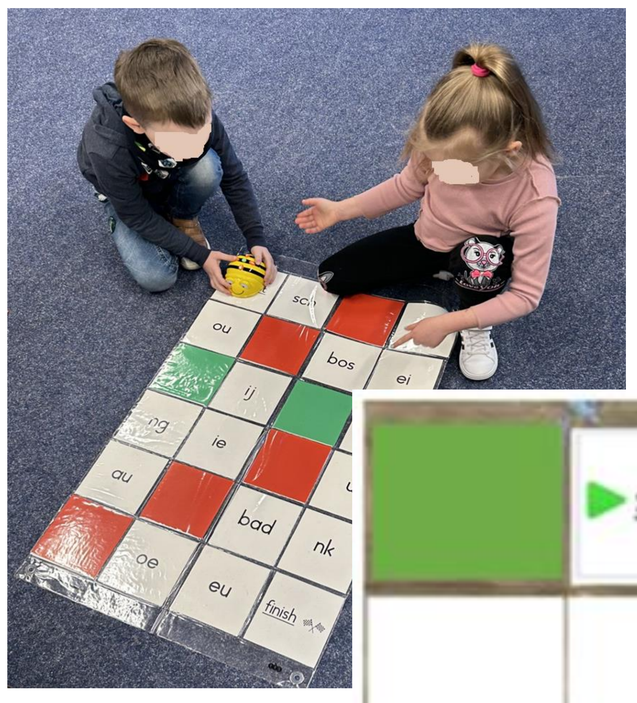
Research objective: "To examine whether and to what extent there is an impact of different types of robotics programming environments on the development of computational thinking with an effect on word reading fluency and decoding".

Outline:

- *Learning to program helps to understand the basic concepts and principles of computer science.*
- *It is argued that programming encourages higher-order thinking and incorporates the thinking ability to solve complex problems and to apply the rules of logic.*
- *Skills obtained from computational thinking (CT) using ICT applications such as educational robotics or other types of programming environments can involve transfer to different school subjects.*
- *CT encompasses more than programming, because problem solving is a skill that is important in multiple disciplines.*
- *It is recommended that CT-skills could be transferred to other learning areas and subjects.*

Method:

- *The study was conducted among Dutch primary school students grade 3 and 4, aged 6 to 8.*
- *For both experimental groups, either BeeBot or Ozobot were applied as robotics programming interventions.*
- *The control group followed regular reading lessons. Reading exercises to be solved by programming applications were designed for both experimental groups.*
- *Via pre-test-posttest design, proficiency on CT was determined by administering the Beginners Computational Thinking Test (BCTt).*
- *To establish reading proficiency, the "three-minute reading ability test" (DMT) was administered.*



BeeBot

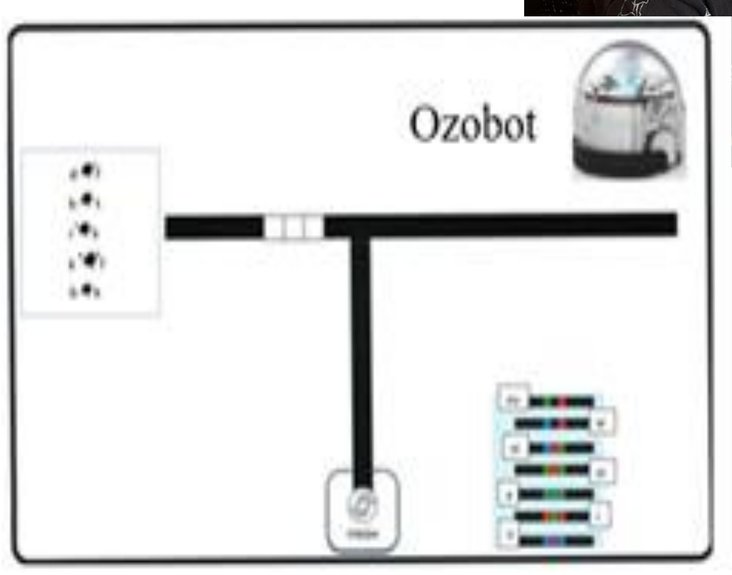


Table 1. Contrast Analysis BCTt Comparing Ozobot, BeeBot and Control group.

Variable	Ozobot - Control group			Beebot – Control goup			Ozobot - Beebot		
	t	*p*	*d*	*t*	*p*	*d*	*t*	*p*	*d*
Total (25)	3.114	0.003*	1.127	0.706	0.842	0.211	1.610	0.112	0.563
Sequence (6)	0.739	0.462	0.217	-1.725	0.089	-0.507	2.139	0.036*	0.725
Loops simple (5)	1.580	0.118	0.382	-0.441	0.660	-0.127	1.724	0.089	0.510
Loops nested (7)	1.500	0.138	0.407	1.197	0.235	0.362	0.220	0.826	0.045
Loops combined (12)	1.889	0.061*	0.559	-0.689	0.493	0.210	-1.003	0.319	0.276
Conditionals if-then (2)	2.615	0.013*	0.747	1.667	0.100	0.489	0.742	0.461	0.259
Conditionals if-then-else (2)	2.478	0.016*	0.696	0.539	0.591	0.155	1.624	0.109	0.541
Conditionals while (3)	1.407	0.164	0.352	0.889	0.372	0.235	0.403	0.688	0.117
Conditionals combined (7)	3.263	0.002*	0.794	-1.407	0.168	0.397	0.397	0.159	0.433

****Table 3.** Comparison analysis of means of the number of correctly read words DMT.

Variable	Ozobot			Beebot			Control group		
	M	*SD*	%	*M*	*SD*	%	*M*	*SD*	%
Total pre-test DMT(300)	0.19	0.133	19.00	0.17	0.152	17.00	0.18	0.119	18.00
Total posttest DMT (300)	0.27	0.137	27.00	0.23	0.180	23.00	0.26	0.131	26.00
Pre-test DMT card 1 (100)	0.30	0.163	10.00	0.28	0.205	9.33	0.30	0.156	10.00
Posttest DMT card 1 (100)	0.39	0.164	13.00	0.32	0.216	10.67	0.40	0.157	13.33
Pre-test DMT card 2 (100)	0.19	0.153	6.33	0.18	0.179	6.00	0.18	0.146	6.00
Posttest DMT card 2 (100)	0.29	0.149	9.67	0.26	0.208	8.67	0.27	0.152	9.00
Pre-test DMT card 3 (100)	0.06	0.092	2.00	0.06	0.080	2.00	0.06	0.077	2.00
Posttest DMT card 3 (100)	0.13	0.107	4.33	0.11	0.123	3.67	0.10	0.098	3.33

Conclusions:

- *A significant increase in CT-level due to applying both code-based programming using Ozobot and tangible-based programming using BeeBot.*
- *The application of Ozobot demonstrates a more substantial increase on CT sub-characteristics than the application of BeeBot.*
- *A contrast analysis indicates that, by applying Ozobot, a significant increase can be observed on the CT sub-characteristics 'total', 'conditionals if-then', 'conditionals if-then-else' and 'conditionals combined', and an almost significant increase on 'loops combined'.*
- *For both the application of BeeBot and the control group, there is significant growth on the CT sub-characteristic sequence' and almost a significant growth on 'loops simple'.*
- *Regarding the level of reading ability, the application of Ozobot appears to demonstrate the largest increase compared to the application of BeeBot and the control group on the administered DMT-test.*
- *Our claims are substantiated by a regression analysis which indicated an overall effect measured and more specific on the characteristics "if-then" and "while" which play a prominent role in both language and Ozobot programming.*

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