The Impact of Computer Programming on Sequencing Ability in Early Childhood

Elizabeth R. Kazakoff
Tufts University

Marina U. Bers
Tufts University

Abstract

This paper examines the impact of a computer programming and robotics curriculum (TangibleK) on sequencing ability in early childhood. Thirty-four children (ages 4.5 – 6.5) participated in computer programming activities with a hybrid tangible-graphical user interface called CHERP. The children learned to build and program robots through three sessions of one-and-one half hours each in a laboratory setting. The participants' sequencing skills were assessed before and after the intervention using a story sequencing task. Pre and post-test scores were compared using a paired sample t-test. A significant increase in post-test scores compared to pre-test scores was found.

Sample

- 34 young children from urban and suburban, public and private, local elementary schools with a mean age of 5.5 years (4.5 – 6.6, *SD* = 0.5).
- 68% males and 32% females with 29% prekindergarten and 71% kindergarten students.
- 67% (according to parents) – 70% (according to children) used computers outside of school
- 62% of our participants had fully/almost fully developed mouse use skills; 17% had moderate mouse use skills; 9% could not effectively use a mouse; 13% did not participate in the assessment
- The average length of participation in the program was 17.8 days (*SD* = 5.7).

Method

Children were evaluated before and after the robotics instruction using an assessment derived from the picture-sequencing test developed by Baron-Cohen (Baron-Cohen et. al., 1986) which consisted of 15 picture stories in five different categories standardized with a group of children ages 3.5 – 5.9, M = 4.5, SD = 0.7. (slightly younger than our sample). The stories in each category are of the same level of difficulty.

For the purpose of our assessment we used one story from each category for the pretest and one story from each category for the posttest to ensure we had a test of equal difficulty for both the pre-test and post-test assessments.

The cards were presented according to the standardized procedure: the children were tasked with putting 4 cards, containing drawings, in order to make a complete story. The first card was given to the child. A correct story earned 2 points, correct first and last picture earned 1 point for a total of 10 possible points.

Results

Picture sequencing pre-test and post-test scores were compared using a paired sample t- test.

- Mean pretest score was 7.06 (*SD* = 2.45)
- Mean posttest score was 8.44 (*SD* = 1.76)
- 19.5% increase in average test score
- A paired t- test found the increase in test scores was significant, t (33) = 2.71, p < .01

"I don't know for sure if it is the robotics, but, I have NEVER had a group of kids pick writing How-To books up as quickly. Additionally, the instructions that they give in the step by step format of How-To books is so detailed and clear. I know I can teach but I'm not **that** good. Just thought you'd find it interesting that what I was seeing with their math skills (specifically showing how they solve problems and the matching proofs) I'm now seeing with literacy. Exciting!!!" **~1st Grade Teacher** (whose students had participated in our robotics program in kindergarten)

Future Directions

- In-classroom lessons & assessment (public & private)
- Sequencing assessment with more room for change
- Larger Control Groups (this study, n= 7, no change)

Significance

This study demonstrates the potential of integrating robotics and computer programming into early childhood learning experiences. Children as young as 4.5 in this study learned to program a robot to complete a variety of challenges and simultaneously improved his/her score on a sequencing assessment.

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