An Exploration of Kindergarten Students’ Use of Perspective and Computational Thinking

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Utah State University
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Overview

Theoretical Grounding
- Perspective
- Computational Thinking (CT)
- Mathematics and CT

The Problem
- Limited research on CT
  - Even Less in Early Childhood

Research Questions
- Perspectives
- CT Skills

Methodology
- Participants
- Data Sources
- Procedures
- Data Analysis

Results
- Perspectives
- Debugging

Future Direction
- Implications
- Practical
- Research
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Focus
Positioning in the Literature

• Computational thinking (CT) is arguably one of the most critical twenty-first century skills (NRC 2010, 2011; Ioannou & Makridou, 2018; Wing, 2006).

• Common elements of CT are: abstraction, decomposition, algorithms, and debugging (Angeli, 2016; Shute et al., 2017; Weintrop, 2016).

• Limited research on CT in early childhood (Bers et al., 2014).

• The available CT research is focused on middle level, high school, and college aged individuals (Yadav et al., 2018).
High school students’ ability to transition from allocentric (3rd) to egocentric (1st) perspectives helped guide them in coding tasks (Smith, Berland, & Martin, 2014).

The field has limited knowledge of how kindergarten students’ perspective is related to their CT skills.

Better understand kindergarten CT skills as they interact with coding robots.
Operationalizing Perspectives

**Egocentric (1st) Perspective**
- Crawling behind the robot
- Gestures and body positioning

**Allocentric (3rd) Perspective**
- Remaining in original position to watch progression

Egocentric Perspective

Allocentric Perspective
Operationalizing one CT Skill

Debugging

- Identifying and modifying an algorithm in attempt to complete a task.
- Identifying, monitoring steps, adjusting codes in sequence
Research Questions

Research Question #1: How do kindergarten students engage in egocentric and allocentric perspectives when engaged in a coding robot task?

Research Question #2: What computational thinking skills emerge during an allocentric or egocentric perspective?
Methods
Participants

1. 4 Students
   (Beginning of larger scale study)

2. Small, Private Kindergarten Classroom

3. 5 Years Old
Coding in Kindergarten Progression of Tasks

Coding Robot Task 1

Coding Robot Task 2

Coding Robot Task 3

Coding Robot Task 4

Our selection for data analysis

Coding Robot Task 5
How do Students use Code-a-Pillar?

Code-a-Pillar

Run the code on the grid to complete a challenge

Students attach code pieces on the body
Data Sources

- Video and Audio Recording

- Two Camera Views:
  - Ground Floor View
  - Researcher Held
Data Analysis

**RQ 1:** Frequency counts of perspectives with pivot tables
  - Double coded 50%

**RQ 2:** Qualitative iterative coding process for CT skills
  - Determined debugging as *critical event* (Powell, Francisco, & Maher, 2003) emerging within egocentric perspective (1st)
Results
## Perspectives

### Table 1

**Kindergarten Students (N = 4)**

<table>
<thead>
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Emergence of CT Skill within Egocentric (1st) Perspective

- From coding perspectives, **debugging** emerged as a critical event while students were engaged in an egocentric (1st) perspective.

- Examples will illustrate this CT skill while students interact with the coding robot.
Shift from Allocentric to Egocentric

- Student tries to code [straight, rotate left, straight].
- Figure 1 is initial code.
- Figure 2 is debug while maintaining allocentric perspective.
- Figure 3 is debug while shifting into egocentric perspective.
Egocentric Helped Debug

• This student engaged in egocentric (1\textsuperscript{st}) by crawling behind the robot and looking straight down his line-of-sight.
• Doing this with her initial incorrect code, she proceeded to successfully debug and create an accurate sequence.
A student attempted to complete a puzzle with a correct sequence of [straight, right turn, straight] while maintaining an allocentric (3rd) perspective. She kept her body in her original position as the robot completed the sequence as well as when she put a new code on the robot.
Summary

A Practical Take-Away:
Kindergarteners’ ability to engage in an egocentric (1st) person perspective may help with debugging of coding robots

Future Directions

<table>
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<tr>
<th>Increase Sample Size</th>
<th>Quantify Effect of Perspective on Debugging</th>
<th>Other CT or Mathematical Skills</th>
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If you have any further questions, please feel free to contact us at jkozlowski@aggiemail.usu.edu.

In addition, please see other work by the Coding in Kindergarten (CIK) research team, funded by a USU Research Catalyst grant.


References


