Programming without a computer: Introducing young children to computer programming

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The Observed Problem

University-level computer science students have difficulty in completing their assignments.
Hypothesis #1

University-level computer science students have difficulty in completing their assignments because they have difficulty in making the transition from concrete thinking to the abstract thinking required.
Hypothesis #2

University-level computer science students will experience less difficulty in completing their assignments if they have experienced a gradual transition from concrete thinking to abstract thinking.
Our Research Question

Can we develop an alternative introduction to computer programming aimed at young children?
Our Approach

Children excel at playing

therefore

explore a tangible environment as an introduction to programming.
Alternative Programming?
Educational outcomes to achieve

• Main idea - teach the learners the basics of programming
  – identify the instructions
  – write down (pseudo code)
  – translate into programming language
  – execute the steps (results)

• The child must be able to:
  – put valid instructions in a specific sequence
  – translate the written instructions into the symbols on the objects
  – place the objects in the correct position and orientation

Source: ICT in Education Usability and Educational Review on: GameBlocks and Body PingPong, Version: 1.0, Test and Data Services, 20-04-2006
Assumptions

• Large, three-dimensional foam blocks.

• Simple programming sequences.

• A symbolic programme to control a robot toy.
Concretising the Result

Humanoid Toy Robot

Lego Toy Robot
Iteration 1

Initial Concept
Acrylic Cubes
Iteration 2

Child-friendly Materials
Limited Instructions
Coding Example

“move forward and then turn right”
Coding Example

“play tune number two and then turn left”
Coding Example
Iteration 3

Recyclable Materials
Recyclable Materials: Rocks
Recyclable Materials: Rocks
Recyclable Materials: Clay
Recyclable Materials: Clay
EVALUATION
Workshops
How we Evaluate

• Consent
• Video and still images for later analysis
• Observer takes notes
• Interactive workshops
• Finish with individual written questionnaires plus drawings
Summary

- Tangible elements, symbolic language.
- No electrical contacts, No text.
- No knowledge of operating a computer required.
- No prior programming knowledge required.
- Low-cost embedded electronics, no need for expensive computer.

- Potential beneficiaries
  - pre-letterates
  - computer-illiterates
  - persons with certain disabilities (loss of sight, poor fine-motor control)
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