7-26-2016

Using a Computer Science-Based Board Game to Develop Preschoolers' Mathematics

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Citation Information

Nivens, Ryan Andrew; and Geiken, Rosemary. 2016. Using a Computer Science-Based Board Game to Develop Preschoolers' Mathematics. Poster presentation. *13th International Congress on Mathematical Education (ICME-13)*, Hamburg, Germany.
https://doi.org/10.13140/RG.2.1.4962.7126

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Introduction

There is a critical need to teach computer science (CS) in order to assure that our nation remains competitive globally [6]. CS is a new basic skill necessary for economic opportunity [6] but is rarely taught before age 6 and only using electronic devices [1]. This presents a challenge for those concerned with "screen time" inherent in electronic devices [2] and for children in poverty with little access to electronic devices [3].

Coding, creating a series of commands that a computer carries out, is a component of CS and can be introduced as early as preschool age and results in increased logical sequencing [5] (putting action commands in order). Missing from the research is the impact of coding with non-electronic formats on logical sequencing with children younger than age 6. Our study fills this need by using a non-electronic format with 4-year-olds.

The purpose is to see if playing *Robot Turtles,* a board game designed to teach coding, will increase logical sequencing skills.

Our hypothesis is that we will see a 10 times greater increase in logical sequencing in the children who play *Robot Turtles* than those playing *Candy Land,* a board game with no measurable effect on math skills [4]

Methods

Subjects: A random sample of 40 4-year-old children attending CSC and LB at ETSU will be selected to participate. Children will be randomly assigned to the treatment or control group.

Treatment:

- The treatment group will play *Robot Turtles (RT)*, a game developed to help children learn logical sequencing skills [7]. Children create sequential commands to navigate the game piece (turtles) using directional cards to reach the goal (capturing the gem).
- The control group will play *Candy Land (CL)*, a game that prior research has shown to have no measurable effect in mathematical skills [8,9]. Note: At the end of the study, the control group will play *RT* order to offer them the same anticipated benefits as the treatment group. in
- Up to 4 players at a time will be seated at a child-sized table. A research assistant (RA) will be proctor and data recorder. To eliminate researcher bias, the RA will use scripts designed for each game. One script will introduce the game and a second script will guide the game play sessions. RAs will be trained on how to play each game, types of questions to expect, and appropriate responses.

Data Collection and Analysis:

- Logical sequencing will be scored on a test of logical sequencing commonly used to test very young children's ability to arrange storyboards [5,4,10]. Researchers will administer the Logical Sequencing test individually to all children pre-test (week 1), mid-test (week 6), and post-test (week 11).
- Prior to the treatment, parents will provide demographic information child's age, gender, and ethnicity, and maternal education and will complete the *Informal Home Numeracy Practices* [11] to provide information on games played at home.
- Videotaping of game play, treatment and control groups, will ensure the games are played with FIDELITY.
- A Two Factor Experiment with Repeated Measures on One Factor Analysis of Variance (ANOVA) will be used to determine the effects of playing Robot Turtles on a task involving Logical Sequencing measure.

Study Schedule

Pre-study: 1 week	Phase 1: 4 weeks	Mid-study: 1 week	Phase 2: 4 weeks	Post-study
Administer logical sequencing assessment Gather data from parents	Treatment: Robot Turtle Play game in groups of 4 Control: Play Candy Land game in groups of 4 Once a week for 15-20 minutes per week	Administer logical sequencing assessment	Treatment: Robot Turtle Play game in groups of 4 Control: Play Candy Land game in groups of 4 Once a week for 15-20 minutes per week	Administer logical sequencing assessment

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Acknowledgements and Contact Information

This research study is supported by funding from East Tennessee State University's Research Development Committee grant.

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