Moving from Equity to Justice in Computing Education for Youth

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Worldwide, youth access to computing instruction is rising
Access isn’t enough; existing inequities still persist.
Outline

Motivation: Access isn’t enough; we need equitable learning outcomes

TIPP&SEE as a Scaffold for Learning Scratch Programming

Improved Student Outcomes with TIPP&SEE

Sneak preview of my current work: Is equity enough?
Open-ended curriculum can be overwhelming for children

**BUILD-A-BAND**

**How can you utilize Scratch to create sounds, instruments, bands, or styles of music that represent the music you love most?**

In this activity, you will build your own music-inspired Scratch project by pairing sprites with sounds to design interactive instruments.

**Start Here**

- Create a sprite.
- Find the music blocks by clicking into the Extensions menu.
- Select “Music blocks.”
- Add sound blocks.
- Experiment with ways to make your instruments interactive.
Scaffolding with Use → Modify → Create
Example Modify Task

Now implement these changes:

<table>
<thead>
<tr>
<th>Coded</th>
<th>Tested</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Make the Marchers move right across the road to the **Speaker**.

Make the Marchers stop when they touch the **Speaker**.

Make the **Speaker** stay still until the Marchers touch her.

Make the **Speaker** move right until she touches the Poster Holder.

Change the Speaker’s costume to “Speaking” so she is facing podium.
TIPP&SEE further scaffolds Use → Modify → Create
TIPP&SEE draws on metacognition

- Metacognition is an understanding of one’s own thought processes
- Metacognition involves both self-regulation & motivation
- Expert learners are metacognitive & strategic
- Strategic learning is covert & non-obvious to less strategic learners
- Learning strategies make these implicit processes explicit
- Learning strategies enable a student to learn, solve problems, and to complete tasks independently
TIPP&SEE guides students in exploring Scratch projects
Title
Instructions
Purpose
Play
Sprites
Events
Explore
TIPP: Inspired by previewing strategies from reading

**Previewing** strategies help students set goals & activate prior knowledge before reading new texts.
TIPP in the Scratch Project Page

Conditional Loops_ Carnival
by ScratchEncore

Instructions
Click on the green flag and the floats will line up for the parade! Click on King Momo to learn more about Carnival!

Purpose: To view a sprite programmed with a conditional loop.

Notes and Credits
Scratch Encore via UChicago STEM Education & University of Maryland - College Park

© Aug 09, 2019
SEE: Inspired by text structure strategies

Text structure strategies help students recognize different kinds of text.
SEE in the Scratch code

Events

Sprites
Outline

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TIPP&SEE as a Scaffold for Learning Scratch Programming

Improved Student Outcomes with TIPP&SEE

Sneak preview of my current work: Is equity enough?
We studied TIPP&SEE in schools in Austin, TX, USA

- We integrated TIPP&SEE into Scratch Act 1
- Scratch Act 1 covered events, sequence, and loops
- Each concept was taught using Use → Modify → Create
- There were assessments at the end of each unit
- Fourth-grade (ages 9-10) classrooms were randomly assigned to control (Use → Modify → Create only) or TIPP&SEE conditions
Students worked on Use → Modify → Create projects
TIPP&SEE students had equal or higher project completion.
TIPP&SEE outperformed control students in assessments

Salac, Thomas, Butler & Franklin (SIGCSE 2020)
Gap between students with & without challenges narrowed when using TIPP&SEE

Students with Economic Disadvantages

Salac, Thomas, Butler & Franklin (SIGCSE 2021)
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Students with Disabilities

Salac, Thomas, Butler & Franklin (SIGCSE 2021)
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Gap between students with & without challenges narrowed when using TIPP&SEE

Students with Below Grade Level Proficiency in Math

Salac, Thomas, Butler & Franklin (SIGCSE 2021)
We also compared across cognitive abilities

- We used the Woodcock-Johnson IV Tests of Cognitive abilities
- WJ IV tests are **not malleable to instruction**, but to development
- We conducted 4 tests:
  - Numbers Reversed & Verbal attention: Short-term working memory
  - Pair Cancellation: Pattern Recognition
  - Visual-Auditory Learning: Long-term memory
- These tests group cognitive abilities into 5 categories: Low, Low Average, Average, High Average, & Superior
Pair Cancellation (pattern recognition measure) had no effect on performance
TIPP&SEE students with low scores on Numbers Reversed (short-term working memory measure) performed as well as Control students with average scores

Salac, Thomas, Butler & Franklin (ICER 2021)
TIPP&SEE students with low scores on Verbal Attention (short-term working memory measure) performed as well as Control students with average scores.
TIPP&SEE students with low scores on Visual-Auditory Learning (long-term memory measure) performed as well as Control students with average scores.

Salac, Thomas, Butler & Franklin (ICER 2021)
TIPP&SEE was linked to improved learning outcomes

- Students using TIPP&SEE completed more project requirements & performed better on computing assessments.
- Students with academic challenges performed as well as students without academic challenges when using TIPP&SEE.
- Students with low short-term & long-term memory abilities performed as well as students with average abilities when using TIPP&SEE.
Key Takeaways:

- TIPP&SEE scaffolds children in exploring example Scratch code, resulting in more equitable outcomes.
- Equitable outcomes won’t be enough unless we question *what* we are teaching & *why*.
- Slow-revealing the layers of algorithmic bias scaffolds children in making sense of & critiquing its impacts.

Resources:

Primary Curricula with TIPP&SEE at [www.canonlab.org](http://www.canonlab.org):

- Scratch Act 1: Intro
- Scratch Encore: Intermediate
- Action Fractions: CS + Math

More examples of Slow Reveal Graphs at [www.slowrevealgraphs.com](http://www.slowrevealgraphs.com)