CIRCL - A Network to Amplify Impact of Technology-Enhanced Learning

The Center for Innovative Research in Cyberlearning seeks to amplify research-based voices by:

- Addressing common needs and new directions
- Building relationships & nurturing communities
- Creating broader impact together

CIRCL is a partnership between:

Digital Promise
SRI Education
EDC
NORC at the University of Chicago

Future oriented
Design oriented
Equity oriented
Community oriented

Funded by grants IIS-1233722, IIS-1441631, IIS-1556486
CIRCL • Connect, Collaborate, Create

Meet Tammy Clegg

CIRCL perspectives offer a window into the different worlds of various stakeholders in the cyberlearning community — what drives their work, what they need to be successful, and what they think the community should be doing. Share your perspective.

Tammy Clegg is a Learning Scientist and an Assistant Professor in the College of Education and the iSchool at the University of Maryland. After receiving her PhD at Georgia Tech working with Janet Kolodner, she conducted a post-doc at the University of Maryland in Participatory Design with Allison Druin, and is now a faculty member at the same University. Her interests are in developing technology to support life-relevant learning environments, participatory design with children.

[Read an interview, which took place January 27, 2018]

Computational Thinking Webinar

1/4/2018

0 COMMENTS

By Pati Ruiz, Sarah Hampton, Riley Leary, Judi Fusco, and Patti Schank

For the last few months, we’ve been reading, thinking, and talking about computational thinking (CT) in preparation for three Webinars for Teachers and Parents on the topic. The webinars are on January 30, February 4, and February 13. Go to the link above to sign up for the webinar and get all the details.

Categories

All Administrators
Author: Judi Fusco
Author: Mary Patterson
CIRCL • Primers, Projects, Designs Themes

Primers

CIRCL Primers are brief summaries of key topics in the field of cyberlearning. They are used to build capacity in the field and to give people a sense of cyberlearning’s main themes. Primers are developed by small teams of volunteers and licensed under a Creative Commons Attribution 4.0 International License.

Want to write or contribute to a primer? Learn how.

| Primers |
|------------------|------------------|
| Computational Thinking |
| Speech Technologies and Learning |
| Data Science Education |
| Persistence in Education |
| Citizen Science |
| Remote Labs |
| Looking Ahead: Trends that will shape Cyberlearning |
| Smart and Connected Communities for Learning |
| Evidence-Centered Design |
| Understanding Universal Design for Learning |
| The Cutting Edge of Informal Learning, Making, Mobile, and More |
| Games and Virtual Worlds |
| Partnering for Impact |
| Technology Enhanced Collaboration |
| Collaborative Educational Data Laboratory |

Cyberlearning Community Report (2017)
Computational Thinking Series Overview

Episode 1
- Overview: computational thinking (CT)?
- CT Terms
- Why is CT important?

Episode 2
- CT in Schools: Primary, Upper Elementary, Middle, and High
- Getting started and schoolwide initiatives

Episode 3
- Parent Episode
- What activities can parents do to support CT development at home?

The Center for Innovative Research in Cyber Learning
CIRCL Educators' Corner
Agenda

- What is Computational Thinking?
- Why Computational Thinking?
- Search Activity
- Resources for Parents
What is computational thinking?

Thoughts from Jeannette Wing

- "A way that humans, not computers, think."
- "A way human beings think about the world and its problems and how we might solve those problems."
- "It is not trying to get humans to think like computers."
computational

thinking

process

problem

solution

concept

idea

abstraction

science

fundamental

powerful

reason

idea

system

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

data

technology

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education

human

structure

data

representation

form

use

modularity

way

mean

help

solve

solving

understanding

learning

teaching

education
Where does computational thinking fit in?

Digital Literacy

Computational Thinking

Computer Science

Programming

This is a remix of Colin Angevine’s work in [http://digitalpromise.org/2017/12/06/advancing-computational-thinking-across-k-12-education/](http://digitalpromise.org/2017/12/06/advancing-computational-thinking-across-k-12-education/) and licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.
Computational thinking (CT) is the range of processes that help people learn by engaging the power of computing to set up and solve problems and automate a broad range of processes.
Computational Thinking Skills

**Problem Decomposition**
Decomposing large complex tasks into manageable modular subtasks

**Abstraction**
Defining multiple layers of abstraction, understanding the relationships between the layers

**Pattern Recognition**
Iteratively developing solutions and systematically detecting and correcting errors through pattern recognition

**Algorithms**
Formulating problems so that their solutions can be represented as computational steps and algorithms
Why Computational Thinking (CT)?

» More prepared to succeed in a technologically-driven economy

» Better equipped for interpersonal relationships and civic participation
The need for digital skills has been steadily increasing.

"High digital skills" jobs grew by 18%.

"Medium digital skills jobs grew by 8%.

"Low digital skills" jobs decreased by 26%.
Computation as a Literacy

- Computational literacy resembles textual literacy (Vee, 2013)
- Computer literacy empowers people (Bers, 2018)
- “Those who can produce digital literacy will do better than those who can only consume them.” (Bers, 2018)
- “Coding is more than a technical skill; it is a way to achieve literacy in the twenty-first century, like reading and writing.” (Bers, 2018)
The Computational Thinking Leadership Toolkit lists all these benefits:

- CT expands children’s **creative process** and their abilities to innovate
- CT prepares students for **success in college**
- CT prepares students to be competitive in a **global workforce**
- CT prepares students for **jobs of the future** and access to **well-paying jobs today**
- CT reinforces and extends **higher-order thinking skills**

The Center for Innovative Research in Cyber Learning
Modeling CT

Binary Search Activity
What is central to the problem and what can be ignored?
What is central to the problem and what can be ignored?

What CT characteristic does that model?
Computational Thinking Skills

**Problem Decomposition**
Decomposing large complex tasks into manageable modular subtasks

**Abstraction**
Defining multiple layers of abstraction, understanding the relationships between the layers

**Pattern Recognition**
Iteratively developing solutions and systematically detecting and correcting errors through pattern recognition

**Algorithms**
Formulating problems so that their solutions can be represented as computational steps and algorithms
Abstraction
Defining multiple layers of abstraction, understanding the relationships between the layers
We can model the problem with fewer doors without losing the heart of the problem. Let’s play the game with 16 doors.
Now play the game with 100 doors.
Now play the original game with 400 doors.
Were there similarities in how to win all three games? Did you find a strategy that worked every time?
Were there similarities in how to win all three games? Did you find a strategy that worked every time?

▶ What CT characteristic does that model?
Computational Thinking Skills

- Problem Decomposition
  Decomposing large complex tasks into manageable modular subtasks

- Abstraction
  Defining multiple layers of abstraction, understanding the relationships between the layers

- Pattern Recognition
  Iteratively developing solutions and systematically detecting and correcting errors through pattern recognition

- Algorithms
  Formulating problems so that their solutions can be represented as computational steps and algorithms
Pattern Recognition
Iteratively developing solutions and systematically detecting and correcting errors through pattern recognition
Were there strategies that worked for the 4x4 that did not scale to the 20x20?
Were there strategies that worked for the 4x4 that did not scale to the 20x20?

What CT characteristic does that model?
Computational Thinking Skills

Problem Decomposition
Decomposing large complex tasks into manageable modular subtasks

Abstraction
Defining multiple layers of abstraction, understanding the relationships between the layers

Pattern Recognition
Iteratively developing solutions and systematically detecting and correcting errors through pattern recognition

Algorithms
Formulating problems so that their solutions can be represented as computational steps and algorithms
Pattern Recognition
Iteratively developing solutions and systematically detecting and correcting errors through pattern recognition
Write a series of steps that explains how to do the strategy we just discussed.
Write a series of steps that explains the strategy we just discussed.

Step 1: Divide the total number of doors by two.

Step 2: If the number is a whole number, open that door. Else, round up to a whole number (or truncate) and open that door.

Step 3: If the number behind the door is the desired number, stop because you found it! Else, go on to step 4.

Step 4: If the number is less than the desired number, eliminate the first half of the doors and loop to Step 1. Else, eliminate the second half of the doors and loop to Step 1.
Write a series of steps that explains the strategy we just discussed.

What CT characteristic does that model?
Computational Thinking Skills

- **Problem Decomposition**: Decomposing large complex tasks into manageable modular subtasks

- **Abstraction**: Defining multiple layers of abstraction, understanding the relationships between the layers

- **Pattern Recognition**: Iteratively developing solutions and systematically detecting and correcting errors through pattern recognition

- **Algorithms**: Formulating problems so that their solutions can be represented as computational steps and algorithms
Algorithms

Formulating problems so that their solutions can be represented as computational steps and algorithms
How Can You Foster CT?
Model it.
When you recognize that you are engaged in CT, start thinking out loud.
Look for opportunities.

<table>
<thead>
<tr>
<th>Point out and praise</th>
<th>Point out and praise kids when you see them using CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encourage</td>
<td>Encourage them to create more efficient solutions when they might be content to just get something working.</td>
</tr>
<tr>
<td>Connect</td>
<td>Connect specific solutions to more general scenarios.</td>
</tr>
</tbody>
</table>
Family Game Night

- Robot Turtles board game
- Computer Science Unplugged activities
- Family Design Journal activities using ScratchJr.
- Try out the game I demonstrated at home

All resources mentioned in this presentation are available on:
http://circlcenter.org/events/computational-thinking-for-teachers-and-parents/resources/
Put that screen time to good use.

Older Kids
- Zoombinis
- Human Resource Machine
- Scratch

Younger Kids
- Scratch, Jr.
- Lightbot
- Daisy the Dinosaur
- Kinderlogo
- Kodeable

Screenshots from Zoombinis app
The 6 Ps
Projects + Peers + Passion + Play + Parents = Phun*

The annoying acorn
“R” Age 6

Fairies Quest
“R” Age 7

The yummy carrot
“A” Age 5

*Am I carrying the P thing too Phar? Don’t forget personalize and persevere!
Human Resource Machine

Maximization Room

Grab TWO things from the INBOX, and put only the BIGGER of the two in the OUTBOX. If they are equal, just pick either one. Repeat!

You got a new command! Jumps only if the thing you’re holding is negative, (less than zero.) Otherwise continues to the next line.

01 jump

02 copyfrom 0
Human Resource Machine
Human Resource Machine

10 and 6 -- first to the out box
2 and 3 -- second to the out box
6 and 6 -- either to the out box
Thinking <> Doing
Types of Resources for CT

**Unplugged activities** -- includes binary search game, board games, card games, puzzles, recipes, & thinking exercises

“**Plugged” or Coding activities** -- includes apps, block & script languages, & robots (make screen time count)

**Robots** -- some require a computer interface; some have tangible interfaces for young kids so no screen time
Tips and Tricks

Learning is more than a “beautiful product” or “dog and pony show”

Projects - kids should lead, parents should help

Play is such an important part of learning

Failure is okay - iteration improves

Learn with your child and show lifelong learning

Learning is messy and can be painful, but it’s part of the process
Final Tip—Have PHUN!

Thank you, Crunchy84 @ Ebay for the basketball game pictures.

Merlin is still alive and well at my house!
Thoughts, Questions, Concerns?

“We believe that those in possession of computational competencies will be better positioned to take advantage of a world with ubiquitous computing. Early experiences with this way of problem solving will....generate interest and prime students for success in this growing field rife with opportunity.”