STEAM Ahead with Interdisciplinary Teaching and Learning
Douglas H. Clements

The Great Debates
- ECE is replete with debates
  - “Child-centered” vs. “Teacher-directed”
  - “Play” vs. “Instruction”
  - “Emergent” vs. “Intentional”
  - “Immediate experience/environment” vs. “Extending the child’s world”
  
  But we wanted to include “All of the above…”

Chicken or Egg?
- “I can’t do this curriculum until I get these behaviors under control!”
  - Well-designed curriculum and activities that are developmentally appropriate prevent challenging behavior.

Spontaneous vs. Planned Science?
- “If you’re looking for a science center, we don’t have them. We believe science is everywhere.”
  - Children discover on their own, but there are words, concepts, and skills that can be more meaningfully introduced by adults, with a well-designed curriculum.
Exploration vs. Instruction?

• “We’re looking for emergent curriculum. We want the children to choose.”
  – One director mentioned pumpkins. Do all preschool children really want to draw pumpkins (and is this most beneficial)?

Great Debates?
Or False Dichotomies?

Literacy as a “Curricular Bully”
(P. David Pearson)

Literacy

STEM, Social Studies...
Connect4Learning Goal

- To develop an interdisciplinary pre-kindergarten curriculum addressing:
  - Science
  - Connected Learning Experiences
  - Mathematics
  - Learning Trajectories
  - Language and literacy
  - Authentic Literacy
  - Social-emotional
  - Pyramid Model
Why an Interdisciplinary Curriculum?

• Many real-world topics and phenomena are inherently interdisciplinary
• Children’s worlds are often not divided neatly into disciplines
• Disciplines can work synergistically

Example Lesson

GROWING SPROUTS

• Measuring the growth of bean sprouts, and recording these measurements in the Science Journal can address:

  - Social Emotional: Working collaboratively to solve a real problem
  - Science: Living things grow over time
  - Mathematics: Length measurement
  - Literacy: Using drawing and writing to record information

Ways in Which C4L is Interdisciplinary

- Consistent teaching approach
- Common topic across disciplines
- Many lessons and experiences simultaneously address objectives from different disciplines
- Instruction and experiences in all disciplines address the same core set of thinking processes

C4L Thinking Processes

While all processes are addressed in all units to some degree, each unit emphasizes a subset of them
C4L Units and Projects

- **Unit 1**: Our Environment
  - Project: Coral Reef
- **Unit 2**: How Structures are Built
  - Project: Making Toys
- **Unit 3**: Exploring Museums
  - Project: Museum Night
- **Unit 4**: Growing our Garden
  - Project: Garden Party
- **Unit 5**: How We've Grown
  - Project: Class Video Yearbook
- **Unit 6**: Classroom Community

Sample C4L Kit Materials

Sample C4L Kit Materials
Focus on Learning Trajectories

C4L Instructional Activities, the teaching activities and strategies, are designed with LTs (goal, development progression, instruction) in mind to help children move to the next level of intellectual development in each domain.

Formative Assessment

- Incorporated as a regular part of daily Small Group lessons
- Math, Science, Social-Emotional
  - assessments organized by lessons and intended objectives
- Literacy
  - assessments organized by learning objectives, independent of specific lessons

Four Types of Daily Lessons

- Welcome and Read Aloud
- Connect
- Small Group
- Fast Focus

Learning Centers

SEE UNIT 1

- Construction Zone
- Dramatic Play
- Book Nook
- Computer Center
- Exploration Station
- Reading
- Listening
- Show What You Know
- Art
- Games & Puzzles
- Writing
Science and Math: Guiding Topics in C4L

C4L begins with sequences of math and science topics at its core, authentically integrating literacy and social-emotional content (and giving them some of their own time, too).

...and this will be a shift for many teachers.

Science

Preschoolers bring a lot to the science table

- Preschoolers bring a lot to the science table (e.g., curiosity!)
- But we don’t provide much preschool science!
  - For example, less than 5% of the time was planned science (Tu, 2006).
  - Science showed the lowest K readiness levels among all 8 HS Outcomes domains (Greenfield et al., 2009).
A Primary Focus of C4L

Research suggests that learner benefit from early science learning experiences. It also tells us that these are nearly absent in most preschool settings. This is NOT the case in a C4L classroom!

Science in C4L

- Based on the idea that children actively construct their own knowledge
- Observing
- Predicting
- Checking Predictions
- Connecting to Prior Knowledge
- Comparing
- Experimenting
- Explaining/Describing
- Measuring
- Recording Ideas and Results

Science cannot be done without using language, literacy tools, and mathematics!

Science Journals

Children regularly use a Science Journal to record their observations and ideas

Science Journals vs. C4L Science – Unit 1

Connecting with School and Friends

- Learning about senses
- Learning about the sense organs
- Value of observing using our senses and science tools

C4L Science – Unit 1

Connecting with School and Friends
C4L Science – Unit 2
Our Environment

• Explore the components of an environment
• Emphasize connectedness among components
• Care for the environment and 3Rs
• Apply knowledge of local environment to understand a new environment
• Engage in flexible thinking
What kinds of open-ended questions could you ask your students during this activity?

What kinds of compare and contrast questions could you ask your students during this activity?

C4L Science – Unit 3
How Structures Are Built

• Explore form and function
• Use relevant features of objects to make predictions and solve problems
• Explore differences between living and non-living things
• Engage in flexible thinking

• Things to Look Forward To...
MULTIPLE NEEDS IN ONE DEED: STEM AND LITERACY EXAMPLE

Albert’s Alphabet: Making an alphabet (form and function)

Let’s read!
C4L Science – Unit 4
Exploring Museums
• Continue exploration of form and function
• Unusual community helpers
• Represent and interpret various representational formats such as drawings, maps, blueprints...
• Understand some ways that people can learn about the past
• C4L spin on the topics children love

C4L Science – Unit 5
Growing Our Garden
• Describe differences between living and non-living things
• Describe origins of some common objects
• Explore characteristics, survival needs, and growth and life cycles of living things
• Engage in simple experimentation, data collection, and reporting of findings

C4L Science – Unit 6
How We’ve Grown
• Learn about the different jobs, hobbies, and work that people do, especially scientists
• Continue to collect data and make records (graphs, charts, etc.)
• Report on data recorded on charts and graphs

SE Connections to Science
• Both SE and Science focus on observation (e.g., recognize emotions in others)
• Science lessons extend the notion of caring, helping, and problem solving to the environment (unit 2 focus)
A Primary Focus of C4L

Early math is surprisingly important! It predicts later school success better than almost anything else.

C4L takes a learning trajectories approach to mathematics, which may be new.

Supporting a Learning Trajectories Approach

C4L approach specifies math ideas and processes and skills young children should master – math learning trajectories
**Overview**

Previous Math Results


**Results**

- Sig. higher for math group on:
  - Information .29
  - Complexity .16
  - Independence .36
  - Inference .16

**Literacy and Language**

Renfrew Bus Story Assessment
C4L Activities

• Teaching in different settings
  – Large groups
  – Small groups (assessment!)
  – Centers
  – Computer centers

SE Connections to Math

• Think, Pair Share: Collaborative problem solving is a focus of both math and social emotional domains
• Use math concept of one-to-one correspondence in social problem solving (Unit 2 Musical Chairs problem solving activity; having 1 toy for 2 friends)
Think, Pair, Share

- Use visuals

![Think, Pair, Share diagram](image)

Moves to Count (and songs, finger plays)

Books

- Sometimes just boring, disconnected.
- Sometimes worse...

![Books image](image)
Books Limited

- 68% include numbers less than or equal to 10
- Only 12% present the number 0 in comparison to 90 percent of the books that presented the number 1.
- Less than ½ present 3 representations (numeral, number word, and quantity)
Subitizing

Subitize!

Tell the children that you have hidden some items under the cloth. Explain that they will play Subitize by using their eyes and brains to quickly make a "picture" of what they see under the cloth. Explain that when we see a number of items we see without counting, we are subitizing.

Without the children seeing the dot-side of the card, cover a card that has two dots, and show the children the cloth-covered card. Tell them to pretend their eyes and brains are cameras (prepared to hold a camera up in front of their eyes) and to get ready to take a picture when you remove the cloth.

Remove the cloth and show the dots for two seconds, then cover the dots again.

Tell the children that you will say, "Ready, set, go!" and they should use their fingers to show how many they saw.

Once you have seen all children's responses, remove the cloth to confirm the number.

Repeat this with a stress-dot card. When it is covered, say, "Let's uncover it and subitize!"

At a Glance

Challenge the children to subitize, or quickly name the number of spots they see, without counting.

Fast Focus

Subitize!

 Ahead of Time
- Gather the following materials: thin, thin, thick, thick, thin, and thick dot cards, and thick and thin dot cards.

Try It!

One teaches, others children, switch roles.
Simon Says—Math & Play

Connect

How Many in My Hand?

What to Do

Explain to the children that you want them to focus on counting with you. Tell them you want to know how many calories you can hold in your hand.

Without the children seeing, hold four 1-inch colored cubes in your hand.

Wave the hand holding the four colored cubes. Then, open your hand, and ask the children to count with you to find out how many cubes you are able to hold.

Remove one of the 1-inch colored cubes from your open hand and place it where children can see it. Ask the child to say one with you.

Continue as you have counted and displayed if the cubes you were holding. Then, open your hand to show that you no longer hold four cubes.

Ask the children how many cubes were in your hand in all. As they reply, count and gesture around four cubes. “Two and two is four. Two hold four cubes in my hand.” Emphasize that, together, you counted and found that you were able to hold four cubes.

Challenge the children to find out using concrete manipulatives how many cubes they can hold in their hands. Tell them you will place the cubes on the construction center for them to use.

Continue the Learning

- Challenge the children to find out how many cubes they can hold in their hands during center time. Encourage them to count by tens.
- On another day, repeat with other numbers and various kinds of concrete manipulatives, making sure children count each of the items aloud with you.
Pemberton Elementary in Wicomico County, Maryland.
Next Step in LT

Surprising Math Learning
C4L Shape – Learning Objectives

Children will

• be able to identify and match shapes, including finding and describing object shapes in their environments
• describe shapes in terms of their attributes
• make shapes from their parts
• compose shapes to make pictures and designs
Activities

- Explore and Match
- Sort and match in centers
- Make designs
- Composition (later)

Parent’s Story of: Vision Test

“Can you see this?”
“Sure, that’s a half cylinder.”
Doctor had never heard—laughing, he said he was very impressed.
C4L Unit 5 Shape – Learning Experiences

- Pattern Block Puzzles
- Tangrams
- Computer learning experiences
- Creation of collages and actual size flowers using colored shapes
Look Inside: Formative Assessment

Rasch scores
p < .0001

ES = 0.72

Pre
Post
Control

CML Math

Fall 06-07
Spring 09

Raw Score (different totals)
Computer
General Curriculum
Small Group
Whole Group
Literacy

In the C4L approach, literacy is used for engaging purposes, meaning it does not supplant learning in other domains, but is integral to such learning.

Beyond the Literacy Basics

7 AREAS OF LITERACY EDUCATION

- Concepts of Print
- Phonological Awareness
- Alphabet Knowledge
- Comprehension
- Vocabulary
- Writing
- Genre Knowledge

"Literacy is building the ability to think."

"...how little research goes into Pre-K"

Authentic Literacy

"Literacy is building the ability to think."

"...how little research goes into Pre-K"

LITERACY/EMERGENT LITERACY

LANGUAGE

CULTURE

RESEARCH

Neil H. Duke is a professor of theory, language, and culture and the director of the Center for the Advancement of the Reading Culture at the University of Michigan. His research focuses on the development of literacy in children and young adolescents from birth to age 18. He is the author of "Beyond the Literacy Basics: Seven Areas of Literacy Education" and the co-author of "Beyond the Literacy Basics: Seven Areas of Literacy Education."
Three Principles of Literacy in C4L

1. Literacy should be developed throughout the day and in all domains.
2. Children need to develop many different literacy skills.
3. Research should guide ECE literacy practices.

Genre

• Comes from a social need.

• Has a specific purpose and accompanying text features.

• Knowledge of one genre does not automatically transfer to other types of genres.
  • For example, fairy-tales.
How-To Texts

UNIT 3

• Are also called “procedural texts”
• Describe a process
• Are instructive
• Provide an opportunity for sequential language

How-To Texts: What We Teach to Kids

UNIT 3

• Title
• Steps
• Pictures
• Materials list

How-To Texts

UNIT 3

1) We read how-to texts.
2) We use how-to texts.
3) We write how-to texts.

Reading How-To Texts

UNIT 3 CENTERS

“First, you made a base for your tower. Second, you added more height to your tower by adding more blocks! Third, you put a wall around your tower.”
(Reading and…) Using How-To Texts

UNIT 3, WEEK 4, DAY 1 SMALL GROUP

Writing How-To Texts

UNIT 3, WEEK 5, DAY 1 SMALL GROUP

How to make a ball

Materials:
- milk jug (2)
- scissors
- 1 ball

Steps:
1. Cut the milk bottle
2. Place the balls on
3. Get the balls out
4. Play with a friend!
Alphabet Knowledge

At its most basic level, letter-sound knowledge involves knowledge about individual uppercase and lowercase letters of the alphabet:
• Names of letters
• Sound(s) associated with letters
• How letters are shaped and formed

SE Connections to Literacy

• Social emotional visuals connect words and pictures with ideas (e.g., center signs, visual schedules, emotion faces/words)
• Social emotional skills taught through high-quality children’s literature – some focused on social emotional, others not
• Positive social interactions encouraged through Think, Pair, Share during read-alouds and small-group work
• Children create books based on social emotional concepts (e.g., We Are Problem Solvers; Class version of On Monday When It Rained)
Why Social-Emotional is a focal C4L domain

- Preschool children are three times more likely to be “expelled” than children in grades K-12 (Gilliam, 2005)

With...Lindsay Giroux

SOCIAL EMOTIONAL RESEARCHER
VANDERBILT UNIVERSITY

Mary Louisa Hemmeter is a professor in the Department of Special Education at Vanderbilt University, and a faculty member of the School of Education, Vanderbilt University, and the School of Nursing. She directs the Vanderbilt Early Intervention Training Program, an inclusive early childhood program. Her research addresses professional development, student teaching, classroom-based research, and addressing challenging behavior, and instructional approaches for young children with special needs. She has published extensively in research publications as well as in materials for classroom and preschool practitioners.

Why Social-Emotional is a focal C4L domain

- Preschool children are three times more likely to be “expelled” than children in grades K-12 (Gilliam, 2005)
In the absence of comprehensive, effective prevention and early intervention, problem behavior intensifies and is less responsive to intervention.

Most challenging behavior can be prevented by early education experiences that promote the development of social emotional competence.

Teachers report that challenging behavior is their number 1 training need and affects their overall job satisfaction. (Hemmeter, Corso, & Cheatham, 2006)

Social Emotional Competence is a protective factor and important for success in school and life.
Unit 3: Managing Strong Emotions

Tucker Turtle presented through many activities:

- Reading the Tucker Turtle Book
- Acting it out
- Making a class Tucker Turtle book
- Singing “When I Feel Angry” song

Three Big Ideas

- Know better, do better
- What we focus on, we get more of
- Challenging behavior represents a missing skill

The CSEFEL Pyramid

THE BASIS OF C4L'S SOCIAL-EMOTIONAL INSTRUCTION

- Intensive Intervention
- Targeted Social Emotional Supports
- High Quality Supportive Environments
- Nurturing and Responsive Relationships
- Effective Workforce

Supporting teachers in responding to challenging behavior; providing individualized supports around other areas

Teaching friendship skills, emotions, and social problem solving

Schedules and routines; Transitions; Directions; Behavior Expectations; Engagement

Connecting with Children and Conversations; Connecting with Families; Collaborative Teaming
Teacher Implementation of Pyramid Model Practices

Observations of Target Children’s Social Skills

Schedules in the Classroom

- Pattern of teacher-directed and child-directed
- Visuals to represent parts of the day
- At eye-level for children
- Ideally arranged left to right
- Way to mark the passage of time
- Way to represent special activities or changes
Personal Connection: Teaching Social Skills

- What would have been helpful for you in the transition?

Responding to Challenging Behavior

Remember this big idea?
Challenging behavior represents a missing skill.

Describe the Behavior
- Interrupting when you are speaking

Describe the Context
- At whole group lessons

Identify the Missing Skill
- If she is interrupting when I’m speaking during whole group, she needs to learn how to raise her hand for a turn.

Teach the Missing Skill
- Explain and model, add picture/visual, have her practice, give positive descriptive feedback.

Think Pair Share

- A child snatches toys from other children when he is wishing for them during center time.
  - What’s the missing skill?
  - What can you do to teach it? What classroom visuals can you use?

- A child always runs around the room during center clean up time.
  - What’s the missing skill?
  - What can you do to teach it? What classroom visuals can you use?
Research / Evaluations

- Most widely used curricula show no empirical benefits in any domain.

Pilot Programs

To date, children in classrooms that have implemented the C4L curriculum have significantly outperformed national norms on measures of math, literacy, and social-emotional learning—including number sense, early geometry skills, vocabulary knowledge, and name writing.
Douglas.Clements@du.edu

Thank You!

Visit

www.C4Lcurriculum.com