PRESCHOOL TEACHERS’ MATH TALK: EFFECTIVE MATH DOMAINS, SYNTAX & PURPOSE

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EASTERN CONNECTICUT STATE UNIVERSITY
Center for Early Childhood Education
CECE Mission

- Conduct research
- Disseminate research findings
- Support teacher educators and others who prepare current and future teachers and providers
- Provide traditional and video-based professional development
Four Crackers (0:45) - Clip #1337
A teacher gives a plate of crackers to a preschooler at snack time and tells him to take four. The child places four crackers on his napkin and counts out loud. The teacher then instructs another child to take four crackers.

Child Counting Pots (0:20) - Clip #1334
A teacher listens to a preschooler as she counts several flower pots in the classroom. The child skips some numbers and some pots as she counts.
CECE Math-Play Studies

2010 TO 2018
Over-Arching Goal

- To discern if teachers can guide mathematical thinking in children without interfering in their play.
- To determine the teacher-child interactions that support both Math and play.
Study 1: Block Play

Math growth

Complexity of structures

Collaboration with peers

Blocks without miniature toys
Study 2: Teachers’ Natural Guidance During Play

1. Fit
- Good-fit
- Poor-fit

2. Content
- Number
- Geometry
- Measurement

3. Process
- Problem-solving
- Reasoning
- Communication
Study 3: Impact on Math Learning

Good-fit interactions

Communication

Number Interactions
Study 4: Impact of Math-Talk PD

- Number & Measurement Talk
  - Growth in Number

- Measurement, Geometry & Spatial Talk
  - Growth in Geometry

- Measurement & Spatial Talk
  - Growth in Measurement
Study 5: What & How of Teachers’ Math-Talk

Math Domains

- Number
- Geometry
- Measurement
- Patterning

Syntactic Structure

- Declarative statements
- Closed questions
- Open-ended questions

Discourse Purposes

- Inform, Guide
- Instruct, Narrate
- Model
- Reason
- Pose Problem
Study 6: Effective Domains, Syntax & Purpose

Objective 1:
Determine the most effective math domain for math-talk

Objective 2:
Determine the most effective syntax

Objective 3:
Determine the most effective purpose
Methodology
Participants: Preschoolers

- 40 children, 3 to 5 years of age
- 50% female
- 7% with identified special needs
- 55% of moderate to high need
- 45% Euro-American, 50% Latino
- 4% African American
- 1% Asian/Indian
Other Participants

Teachers
- 4 classrooms with each a head teacher, assistant teachers and an associate teacher
- Educational background included master’s and bachelor’s degrees and several years of teaching experience.

Researchers
- Two early childhood education researchers
- 4 undergraduate research assistants
Procedures

- **Pretests**
  - TEAM
  - Sept-Oct.

- **Data**
  - 5 rounds of video data
  - Captured-transcribed-coded

- **Posttests**
  - TEAM
  - May
# Math Talk Coding Instrument

**File Name:** Spencer16/Round 1/Teal Room/T1/T1a

**Classroom:** __Teal__

**Transcriber:** __Stefanie__  **Coder:** __Sarah__  **Date:**

<table>
<thead>
<tr>
<th>Time</th>
<th>Num Domain</th>
<th>Geo. Domain</th>
<th>Meas Domain</th>
<th>Patterns</th>
<th>Syntax</th>
<th>Purpose</th>
<th>Effect on Play</th>
<th>Transcript</th>
</tr>
</thead>
<tbody>
<tr>
<td>07:14:54</td>
<td>N-sym</td>
<td>G-spatial</td>
<td>M-meas</td>
<td>P-ident</td>
<td>S-declar</td>
<td>T-inform</td>
<td>Unob Instrus</td>
<td>&quot;My friends, all three of us can use it, right?&quot;</td>
</tr>
<tr>
<td>09:34:08</td>
<td>N-sym</td>
<td>G-shapeideg</td>
<td>M-meas</td>
<td>P-create</td>
<td>S-closedq</td>
<td>T-Guiding</td>
<td>Unob Instrus</td>
<td>What other shapes will fit that space?</td>
</tr>
<tr>
<td>Domains</td>
<td>Number (Num)</td>
<td>Geometry (Geo)</td>
<td>Measurement (Meas)</td>
<td>Patterns (Pat)</td>
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<tr>
<td>Subcategories</td>
<td>Symbol</td>
<td>Spatial location</td>
<td>Measuring object</td>
<td>Identify a pattern</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Counting objects present</td>
<td>Counting objects present</td>
<td>Spatial location</td>
<td>Measuring object</td>
<td>Identify a pattern</td>
<td></td>
<td></td>
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<tr>
<td>Abstract counting</td>
<td>Abstract counting</td>
<td>Shape identification</td>
<td>Comparing measurements</td>
<td>Create a pattern</td>
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<td></td>
<td></td>
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<tr>
<td>Cardinality</td>
<td>Cardinality</td>
<td>Shape identification</td>
<td>Comparing measurements</td>
<td>Continue a pattern</td>
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<td></td>
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<tr>
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<td>Ordinality</td>
<td>Shape identification</td>
<td>Comparing measurements</td>
<td>Continue a pattern</td>
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<tr>
<td>Combination</td>
<td>Combination</td>
<td>Shape identification</td>
<td>Comparing measurements</td>
<td>Continue a pattern</td>
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<tr>
<td># of objects</td>
<td># of objects</td>
<td>Shape identification</td>
<td>Comparing measurements</td>
<td>Continue a pattern</td>
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### Syntax, Purpose, Effect on Play

<table>
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<tr>
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<th>Effect on Play</th>
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<tbody>
<tr>
<td>Declarative statements</td>
<td>Informing</td>
<td>Unobstrusive</td>
</tr>
<tr>
<td>Closed Questions</td>
<td>Guiding</td>
<td>Instrusive</td>
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<tr>
<td>Open-ended Questions</td>
<td>Instructing</td>
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<td>Narrating</td>
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<td></td>
<td>Reasoning</td>
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<tr>
<td>Posing closed problem</td>
<td></td>
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<tr>
<td>Posing open problem</td>
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<tr>
<td>Modeling</td>
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# Math Talk Coding Instrument

**Math Talk Coding Instrument (sample)**

File Name:  _Spencer16/Round 1/Teal Room/T1/T1a_  Classroom:  _Teal_

<table>
<thead>
<tr>
<th>Transcriber:</th>
<th>Stefanie</th>
<th>Coder:</th>
<th>Sarah</th>
<th>Date:</th>
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</thead>
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<th>Transcript</th>
</tr>
</thead>
<tbody>
<tr>
<td>09:34 2:08</td>
<td>N-sym N-cpres N-ord N-comb</td>
<td>G-spatial G-composition G-attributes G-tranform</td>
<td>M-meas ob M-compare</td>
<td>P-ident P-create P-contin</td>
<td>S-declar S-closedq S-openque s</td>
<td>T-inform T-Guiding T-Instruct T-Narrate T-Reasoning T-Pose closed T-Pose Open T-Model</td>
<td>Unob Intrus</td>
<td>What other shapes will fit that space?</td>
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</tr>
<tr>
<td>09:34</td>
<td>N-sym</td>
<td>G-spatial G-shapeid G-composition G-attributes G-tranform</td>
<td>M-meas ob M-compare M-order</td>
<td>P-ident P-create P-contin</td>
<td>S-declar S-closedques S-openques</td>
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<td>Unob Intrus</td>
<td>What other shapes will fit that space?</td>
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</table>
Data and Data Analysis

DATA

7957 codes
Reliability of coding established close to 100%

DATA ANALYSIS

Hierarchical multiple regression analysis

**Dependent variable:** Post-test TEAM scores

**Independent variables:**
1. Frequency of math-talk categories
2. Pretest
3. Age
4. SES
5. Gender
Results
## Model 1: Age, SES, Gender & Pretest

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>Sig.</th>
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<tbody>
<tr>
<td>Age</td>
<td>5.76</td>
<td>3.44</td>
<td>.22</td>
<td>1.68</td>
<td>.10</td>
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<tr>
<td>SES</td>
<td>1.83</td>
<td>1.71</td>
<td>.11</td>
<td>1.07</td>
<td>.29</td>
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<td>Gender</td>
<td>3.34</td>
<td>3.17</td>
<td>-.12</td>
<td>-1.06</td>
<td>.30</td>
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<tr>
<td>Pretest Scores</td>
<td>.79</td>
<td>.16</td>
<td>.63</td>
<td>4.81</td>
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</table>
Model 2: Math Sub-categories

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>Sig.</th>
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<tbody>
<tr>
<td>Abstract Counting</td>
<td>.79</td>
<td>.14</td>
<td>.32</td>
<td>5.77</td>
<td>.00*</td>
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<tr>
<td>Cardinality</td>
<td>.11</td>
<td>.06</td>
<td>.11</td>
<td>1.72</td>
<td>.05*</td>
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<tr>
<td>Ordinality</td>
<td>.16</td>
<td>.05</td>
<td>.04</td>
<td>3.18</td>
<td>.01*</td>
</tr>
<tr>
<td>Attributes</td>
<td>.30</td>
<td>.09</td>
<td>.16</td>
<td>3.54</td>
<td>.00*</td>
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</tbody>
</table>
## Model 3: Syntax

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>B</th>
<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed Question</td>
<td>-.06</td>
<td>.10</td>
<td>-.06</td>
<td>-.61</td>
<td>.55</td>
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<tr>
<td>Declarative Statement</td>
<td>.03</td>
<td>.06</td>
<td>.04</td>
<td>.45</td>
<td>.66</td>
</tr>
<tr>
<td>Open-Ended Question</td>
<td>.77</td>
<td>.11</td>
<td>.50</td>
<td>6.98</td>
<td>.00*</td>
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</table>
## Model 4: Purpose

<table>
<thead>
<tr>
<th>Independent Variable</th>
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<th>Std. Error</th>
<th>Beta</th>
<th>t</th>
<th>Sig.</th>
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</thead>
<tbody>
<tr>
<td>Informing</td>
<td>.05</td>
<td>.12</td>
<td>.03</td>
<td>.42</td>
<td>.68</td>
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<tr>
<td>Instructing</td>
<td>.00</td>
<td>.25</td>
<td>.00</td>
<td>.01</td>
<td>.99</td>
</tr>
<tr>
<td>Modeling</td>
<td>.43</td>
<td>.23</td>
<td>.19</td>
<td>1.89</td>
<td>.04*</td>
</tr>
<tr>
<td>Narrating</td>
<td>-.11</td>
<td>.28</td>
<td>-.03</td>
<td>-.38</td>
<td>.71</td>
</tr>
<tr>
<td>Posing a Closed Problem</td>
<td>-.22</td>
<td>.12</td>
<td>-.15</td>
<td>-1.79</td>
<td>.09</td>
</tr>
<tr>
<td>Posing an Open Problem</td>
<td>.69</td>
<td>.15</td>
<td>.43</td>
<td>4.61</td>
<td>.00*</td>
</tr>
<tr>
<td>Reasoning</td>
<td>-.11</td>
<td>.18</td>
<td>-.04</td>
<td>-.62</td>
<td>.54</td>
</tr>
</tbody>
</table>
Implications

1. What we say (not how often) does matter
2. Talk about deeper concepts
3. Pose open-ended questions/problems
Why did we study math in **PLAY**?

Percentage of preschool day devoted to play: 64% (Fuligni et al., 2012)

Play involves mathematical thinking (Sarama & Clements, 2009; Ginsberg, 2006).

- **Blocks** (Hanline, 2010a; Wolfgang et al., 2001; Trawick-Smith et al., 2016)
- **Construction toys** (Wolfgang et al., 2003)
- **Pretend play** (Hanline, 2010b)
- **Board games** (Ramani & Siegler, 2008; Siegler & Ramani, 2009; Stebler et al., 2013)
- **Water play** (Trawick-Smith et al., 2014)
- **Puzzles** (Levine et al., 2012)
Play Pedagogy: Three Perspectives

Enhancing Play
- Play, by itself, promotes development in many domains.

Enhancing Academic Content through Play
- “Good-fit” teacher-child interactions, including rich conversations about math, promote a deeper understanding of math concepts. but also apply them.

Specific play activities support Math learning
- Block Play, Water Play
- Puzzles, Pretend Play, Board Games
Challenging Math Talk in Play

**NOT AS CHALLENGING**

- Let’s count the blocks, 1, 2, 3...
- What shape is this?

**MORE CHALLENGING**

(ENGEL, CLAESSONS, & FINCH, 2013)

- How many blocks do you have? How do you know you have 7?
- How many tickets do you need for your family?
- Why is this a triangle?
- What other shapes would fit here?
Contact

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Jeffrey Trawick-Smith: trawick@easternct.edu
Julia DeLapp: delappj@easternct.edu

Videos/research briefs: www.easternct.edu/cece
Supporting Early Mathematical Development

From a very early age, children are naturally interested in exploring size, shapes, and quantities. Preschoolers begin to count, sort materials by different characteristics, and recognize shapes. These
SUPPORTING MATHEMATICAL DEVELOPMENT IN YOUNG CHILDREN (SERIES)

These videos describe children’s early mathematical development and provide examples of how adults can explicitly teach math skills and support their development through daily routines and play. Math areas covered include:

- Counting (3:57)
- One-to-one correspondence (4:08)
- Cardinality (4:42)
- Recognition of quantity (3:49)
- Comparison (3:51)
- Number operations (4:35)
- Measurement (5:30)
- Data (4:32)
- Geometry (5:15)

SEE MORE→

INCORPORATING MATH INTO GROSS MOTOR

In this "Reflection from the Field," preschool activity in an obstacle course using toy trucks, prepare her students for kindergarten, she sorts skills while incorporating gross motor express how an activity similar to this can be fun and creative ways.

SEE MORE→

USING MATH TALK WITH PRESCHOOLERS TO SUPPORT LEARNING (5:17)

While many preschool classrooms use explicit, teacher-directed activities to help children develop basic math skills, recent research from the Center shows that a lot of math learning occurs within the context of classroom play, especially when teachers are talking with children about how to solve problems involving number. In this e-clips video, Dr. Sucha Swaminathan and Dr. Jeffrey Trawick-Smith discuss the importance of talking with children about numbers and encouraging them to explain their mathematical processes. When teachers and children engage in regular conversations about quantities, measurement, and size, children will gain mathematical and general cognitive skills.

SEE MORE→

THE RELATIONSHIP OF TEACHER-CHILD INTERACTIONS IN PRESCHOOL PLAY TO YOUNG CHILDREN’S MATHEMATICAL ABILITIES (11:02)

Math ability in preschool is one of the best predictors of later school success—research suggests it is a better predictor than early literacy skills. While many studies have found strong relationships between young children's play and literacy, studies of teacher interactions in play and mathematics learning have not been conducted. This edition of “Research Clips” describes findings from a study aimed at identifying classroom interventions in play that are associated with math achievement in three- and four-year-olds. The findings indicate that how teachers interact with and communicate with children while they play has powerful impacts on children’s mathematical learning.

SEE MORE→