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USING CONCEPT MAPS TO PROMOTE THE EMERGENT LITERACY SKILLS OF 3- TO 5-YEAR-OLD CHILDREN

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Abstract. In this paper we report the findings from a study designed to investigate the associations among young pre-reading children's concept development, oral language development, and emergent writing skills when their teachers used concept maps to support instruction. The 40 sampled children attended 12 classes in four elementary schools. The children's classes included children of poverty and with special needs. Data included pre- and posttest writing and language samples. Concept mapped language samples provided the concept development measures. Findings suggest that, on average, girls' writing samples scored higher than boys' at pretest. Results indicated that children made gains from pretest to posttest in concept map scores and the number of words and the number of different words in the language scores. Gains made from pretest to posttest were not differentiated by gender. Finally, gains made on concept map scores were associated with gains in number of words and number of different words, but not with mean length of utterances.

1 Introduction

In this paper we describe a professional learning series in which participating teachers engaged in face-to-face training sessions, webinars, and coaching. Researchers used concept maps in the delivery of the series and taught teachers how to use concepts maps with children in their classes. The 2011-12 academic year, an exploratory year, was the first of a 3-year project designed to enhance young pre-reading children's content knowledge and oral and written language development. The project (HUBS) design involved formative and summative evaluation of the developmental changes of the children taught by participating teachers.

Research documents a school readiness gap between children living in poverty and their more affluent peers (U.S. Department of Education, National Center for Education Statistics, 2003). When children enter kindergarten with limited readiness skills they are more likely to develop reading difficulties and require remedial education (Schweinhart, 2003). What and how much children learn is highly dependent on the adults with whom they interact and the environments in which they learn. Thus, to close the readiness gap, successful professional learning opportunities increase teachers' awareness of the importance of engaging children in high-quality classroom conversations, and providing opportunities for children to participate in multiple activities designed to enhance their concept development and literacy skills

Key learning opportunities necessary for young children to achieve school success include language development activities, instruction in phonological awareness, opportunities for children to engage in writing and drawing, and the frequent reading of informational texts (Neuman, Roskos, Wright, & Lenhart, 2007). Using informational texts with young children improves their language skills while increasing content area knowledge (Pentimonti & Justice, 2011). Neuman (2006) emphasized the connection between children's background knowledge and their reading comprehension. Siegler (2001) emphasized learning as the central connection between instruction and cognition; thus, the more one knows about a topic, the better one understands, learns, and remembers related information.

Language plays a key role in young children's learning. Language allows children to voice their thoughts and feelings, helping them to better understand themselves, others, and new experiences (Bell & Westberg, 2009). It is the challenge of teachers to assure that the children who come to school with few language experiences are provided with the opportunities they need to become successful, life-long learners (Justice, Mashburn, Hamre, & Pianta, 2008).

Children who are encouraged to draw and write stories in the preschool years more easily and confidently become writers than children who have not had early writing experiences (Schickedanz & Casbergue, 2009). The goal of writing instruction is to teach children about writing as a form of communication rather than how to correctly form letters of the alphabet (Bodrova & Leong, 2007). Preschool provides a wonderful opportunity for teachers to model writing skills and engage children in writing activities that support and encourage their development as writers.

2 Theoretical Background

Cognitive and learning sciences provide insights and strategies that form the foundation for the teaching and learning processes that support children's emergent literacy skills. Strategies include working with children's preexisting understandings; building competence by scaffolding children's factual knowledge while developing a conceptual framework using strategies that facilitate retrieval and application; and using Vygotsky's zone of proximal development to help teachers scaffold children's learning using questions and discussions in ways that advance their thinking and problem solving (Vygostsky, 1978).

Educational researchers have long seen concept mapping as a powerful tool to promote meaningful learning (e.g., Novak & Cañas, 2008; Novak & Gowin, 1984). Concept maps are non-linguistic, two-dimensional, hierarchical diagrams that result from systematically mapping the relationships among concepts, and their use helps individuals visualize the structure of the mapped knowledge. On concept maps, directional lines articulate the relationship between related concepts. Linked concepts form propositions and, when read, propositions form meaningful statements. Cross-linked propositions link concepts across different map segments.

The Institute of Human and Machine Cognition (IHMC) broadly summarized the uses of concept mapping in educational settings as support for learning, assessment of learning, and for the organization and presentation of knowledge. Support of learning applications include schematic summaries of what children know, displays of children's prior knowledge, summaries of what has been learned, and detection of misconceptions. Assessment applications of concept mapping include formative and summative assessments and the documentation of changes in children's conceptual knowledge. Teachers use concept maps as advance organizers to scaffold learning and present knowledge for course and curriculum development. Teachers also use classroom concept maps, constructed by teachers or other experts, to present a global overview at the beginning of a unit and also to scaffold learning throughout the unit (Coffey et al, 2003).

3 Intervention

A university research center located in the southeastern United States is working in partnership with a large urban school district to implement a professional learning series designed for teachers of general education and special needs children between the ages of 3 and 5 years. Traditionally, these teachers have trained and functioned in isolation but, in this project, they work together in a professional learning hub (HUBS) building a collaborative network of teachers using technology applications to improve instructional and interactional classroom practices. HUBS, a 3-year project began in November 2011 and will end in June, 2014. Teachers participate in 90-minute, biweekly professional learning seminars and webinars focused upon improving children's concept development, strengthening their oral language skills, and moving them along the emergent writing continuum. Additionally, on-site coaching includes biweekly classroom visits by a center researcher, along with additional visits for technological support.

During the professional development sessions, teachers learned to increase children's background knowledge and concept development through the use of informational texts and class concept maps. Furthering this effort, project researchers developed a set of informational books designed to support young children's concept development related to physical health. Each book includes a concept map that summarizes the structure of the knowledge presented in the book and provides a graphic organizer for children to use to visualize the connections among concepts. Monthly, teachers received a new book and engaged in discussions concerning strategies for using the book and the embedded concept map to explicitly teach the connections between presented concepts and the children's previously held knowledge. (See Figure 1 for an example of a class concept map.)

Teachers also learned to support the development of children's oral language and discourse skills by increasing the quality and quantity of classroom conversations involving individual children. During the training sessions, teachers learned how to use strategies facilitating oral language development and promoting conversations. These strategies included *cueing talk through expectant looks, using comments as well as questions to encourage child talk, making words more salient through stress or repetition,* and *rewording children's responses to expand on what they say* (Justice, Mashburn, Hamre, & Pianta, 2008). Teachers and researchers revisited these strategies during webinars and classroom visits to demonstrate learning activities using informational books and concept maps.

Training session topics also included strategies that teachers can use to support the development of children's writing abilities. Teachers learned to engage children in writing activities and to assess student progress biweekly by collecting writing samples from each child and then rating the samples using the Emergent Writing Rubric (McLemore, 2011). Teachers used the results to plan instruction designed to move children along the writing continuum.

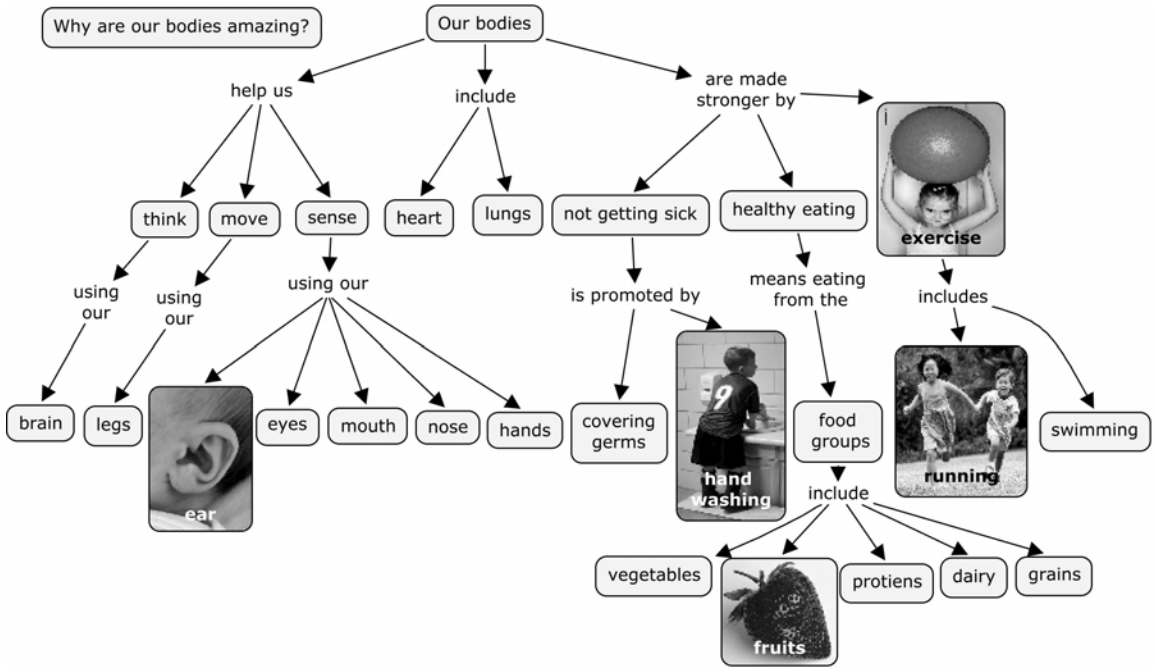

Figure 1: The class concept map with all but five pictures removed. The concept map used with the children had pictures for all concepts.

The purpose of this paper is to present results of a study, embedded in the HUBS project, designed to investigate relationships among young, pre-reading children's concept development, oral language, and emergent writing skills when using concept maps to support instruction. Research Questions (RQ) include:

RQ1 What was the children's initial developmental status in writing, language, and content knowledge relative to the physical health lessons? Was the initial status of the children relative to the physical health lessons differentiated by gender?

RQ2 Did children make statistically significant gains from pre- to posttest in the development of their writing, language, and content knowledge relative to the physical health lessons? Were gains differentiated by gender?

RQ3 Were gains in the children's development in writing, language, and knowledge content relative to the physical health lessons different, thus, indicating differentiated development in these areas?

4 Methodology

The sample included 40 children attending 12 classes enrolling 3- to 5-year-old children in four elementary schools primarily enrolling children of poverty. The classes included six general education classes enrolling 4- and 5-year olds, one blended class that included special needs children, and five classes enrolling 3- and 4-year-old children with special needs. We sampled four children from each class; collecting pretest writing and language samples from March 26 to April 4 and posttest writing and language samples May 14 to May 30. The children were mostly boys (52.5%), mostly Black (62.5%), and lived in poverty (70.0%). Additionally, 35% of the children were developmentally delayed and at least 5% were English Language Learners (ELL).

The children's teachers collected writing samples and audio-recorded language samples. The teachers first modeled writing and then prompted the children by saying: *You have been learning about your amazing body. Write and draw about your amazing body.* The children used *iDairy* on the teacher's iPad2 or paper, pencil, crayons, and/or markers to create their writing/drawing. We assessed the children's writing using a research-based 8-point emergent writing rubric (McLemore, 2011). A rating of 1 reflects that the child is making marks that show no intention to create a finished product, no understanding of the different purposes for writing, and

no connection between the writing and a message; and a rating of 8 reflects appropriate use of letter case, punctuation, a central message, is easily read, and shows that the child is working toward conventional spelling. (See Figure 2 for pretest and posttest writing samples.) The two writing samples were taken from a 4-year-old girl from a low-income family. The first sample, "Me and Mom garden" scored *6* on the Emergent Writing Rubric because she wrote beginning sounds to represent words. The second sample, "I dance" was collected two months later and scored *7* because she wrote letters to represent the beginning, middle, and ending sounds in words.

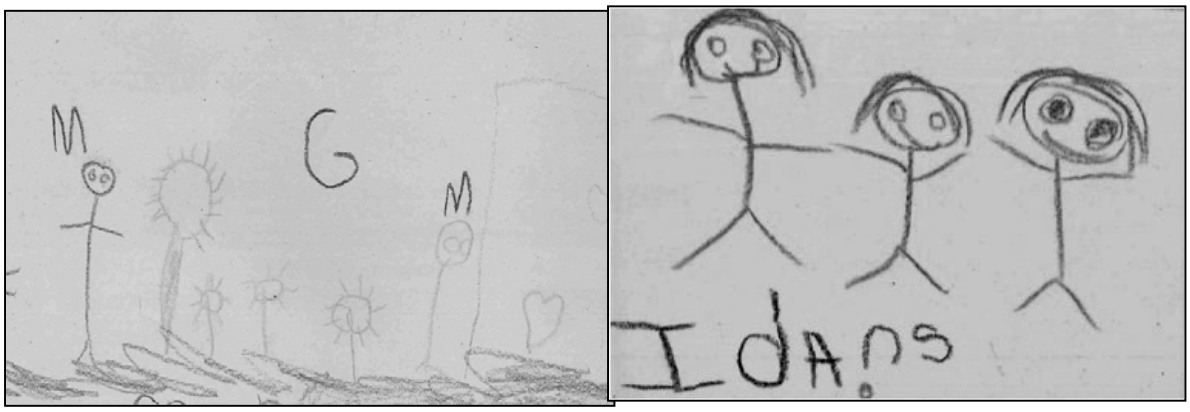

Figure 2: Pretest (left-side sample) and posttest (right-side) writing samples.

The teachers also collected language samples by engaging the children (one-on-one) in a typical classroom conversation by saying *Tell me what you know about your amazing body*. Teachers further encouraged the children to make fuller responses using prompts such as *What else can you tell me?* and *What do you mean by that?* A concept map similar to the one shown in Figure 1 served as a prompt for the conversation; however, the concept maps had pictures depicting all concepts. The concept map used at pretest included just the five senses section of the Figure 1 concept map, and the posttest concept map included all concepts on the Figure 1 concept map. We transcribed language samples and used a computer program to analyze the transcriptions. Output measures included the number of words (NW), number of different words (NDW), the Type Token Ratio (TTR) which is the ratio of NDW to NW, and the mean length of the utterances (MUL). (See Figure 3 for an example of a pretest language transcription.)

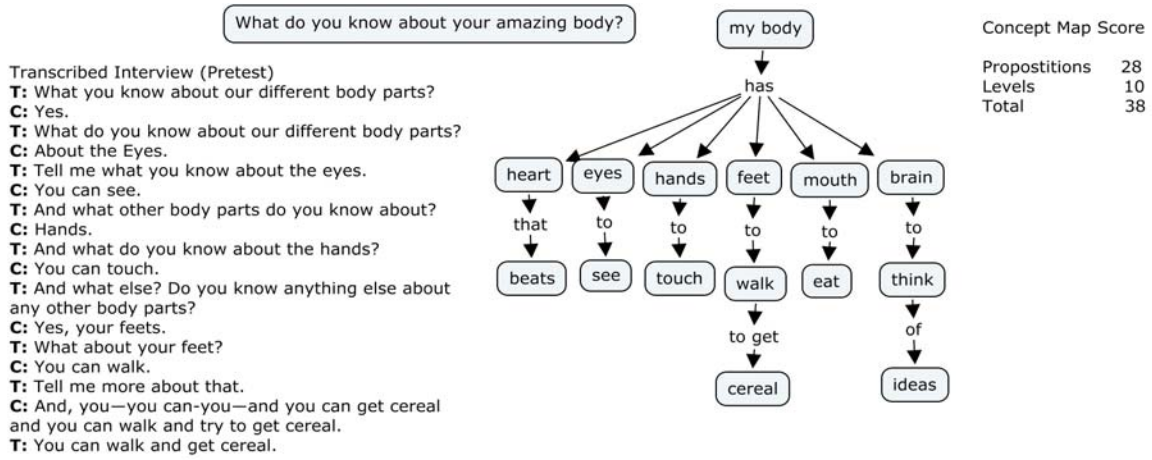

Figure 3: Transcribed interview and concept map.

Trained researchers developed concept maps from the language samples and scored them (Wehry, Algina, Hunter, & Monroe-Ossi, 2008). To address the complexity of the knowledge structure mapped, we differentially scored the quality of the propositions (McClure, & Bell, 1990). In doing so, we increased the threshold for awarding cross-link and hierarchy level points—the concept map components that often reflect creative thinking: Propositions received no points if incorrect or irrelevant; 1 point if correct and somewhat relevant and 2 points if correct and relevant. Cross-linked propositions received 5 points when they linked concepts that were part of a proposition awarded at least 2 points; otherwise, cross-links scored as propositions. Hierarchy level one, the focal concept, received no points. Hierarchy levels two and three received 5 points when three or more

concepts formed quality propositions with the next higher hierarchy. (Figure 3 is an example of a concept mapped pretest language sample.)

We analyzed the mean scores of the pretest concept maps and language samples using ANOVA techniques to determine if they were initially differentiated by gender. We analyzed the pre- and posttest mean scores using repeated measures ANOVA techniques to determine whether the children made gains across time and whether gains were differentiated by gender. The writing sample scores were placed on a matrix with pretest scores as rows and posttest scores as columns showing the children's initial status and their gains and showing whether either measure was differentiated by gender. We used Kendall's Tau-b and Hoeffding's Dependence coefficients to determine if the children's growth in concept knowledge was independent of their growth in language.

5 Results

First, we will present results from the writing samples. Table 1 presents the pretest and posttest scores by the children's age and gender (19 girls and 21 boys). The five youngest children were boys and had the expected lowest scores. However, of the children with initial scores of *6* or *7*, 12 were boys and 17 were girls. Of the older children scoring *5* or less, three were boys and two were girls. Thus, we conclude that the initial status of the girls' writing samples was higher than those of the boys. All but one child either made gains or sustained their initial status. Children making gains either advanced one position on the rubric (18 children, 11 boys and 7 girls) or advanced two positions (1 boy).

		Post Writing Level					**Total**
		3	**4**	**5**	**6**	**7**	
Pre Writing Level	**2**	**2**$^{3♂}$	**1**$^{3♂}$				4
	3		**(2**$^{3♂}$**+1**$^{♀}$**)**				2
	4			**2**$^{♂}$			2
	5		**1**$^{♂}$	**1**$^{♀}$	**1**$^{♂}$		3
	6				**(5**$^{♂}$ **+ 6**$^{♀}$**)**	**(4**$^{♂}$ **+ 6**$^{♀}$**)**	21
	7					**(3**$^{♂}$ **+ 5**$^{♀}$**)**	8
	Totals	2	5	3	12	17	40

Note: 3♂ is 3- to 4- year boy; ♂ is a 4- to 5-year old boy; and ♀ is a 4- to 5-year old girl.

Table 1: Writing Results

Next, we report the sample statistics for the concept map and language sample scores. Statistics for the pretest, posttest, and difference of the two are reported for all sampled children and separately for boys and girls in Table 2. The mean scores indicate a 35-word increase in the number of words spoken (NW) and a 21-word increase in the number of different words spoken (NDW).

		Pre		**Post**		**Difference**	
		M	***SD***	***M***	***SD***	***M***	***SD***
Cmap	All	36.3	12.6	59.8	17.4	23.5	17.4
	Boys	35.5	12.6	56.6	16.3	21.1	8.9
	Girls	37.2	12.8	63.3	18.4	26.1	23.7
Language							
NW	All	42.7	20.7	77.9	48.3	35.2	41.1
	Boys	42.2	19.1	71.3	43.0	29.0	37.1
	Girls	43.2	22.8	85.2	53.8	41.9	45.1
NDW	All	25.1	9.6	46.3	18.9	21.2	17.4
	Boys	26.0	10.3	44.2	18.9	18.1	16.8
	Girls	24.1	8.8	48.5	19.2	24.5	18.0
TTR	All	1.7	0.4	1.6	0.5	-0.1	0.5
	Boys	1.6	0.4	1.5	0.4	-0.1	0.5
	Girls	1.7	0.4	1.6	0.6	-0.1	0.5
MUL	All	3.0	2.3	2.8	1.5	-0.3	1.4
	Boys	2.5	1.0	2.6	1.2	0.1	1.0
	Girls	3.5	3.2	2.9	1.8	-0.6	1.7

Table 2: Sample Statistics for the Concept Map and Language Sample Measures

Table 3 presents the statistical results addressing RQ1 and RQ2 for the concept map and language sample measures. As can be seen, regarding RQ1, concept map and language pretest scores (initial status) were not differentiated by gender with *p*-values ranging from a low of .170 for MUL to a high of .884 for NW. Regarding RQ2, statistically significant gains from pre- to posttest were made for the concept map, NW, and NDW scores, but not for the TTR or MUL scores. Gains were not differentiated by gender, nor were any interactions between gender and time evident. Thus, on average, children's language development in the areas of NW and NDW and their concept development improved from pretest to posttest.

Measure	*F*	*p*
RQ1		
Cmap	0.2	.679
NW	<0.1	.884
NW	0.4	.517
TTR	0.5	.492
MUL	2.0	.170
RQ2		
Cmap	72.6	<.001*
Sex	1.1	.297
Sex*Time	0.8	.376
NW	29.3	<.001*
Sex	0.6	.456
Sex*Time	1.0	.328
NDW	58.9	<.001*
Sex	0.1	.766
Sex*Time	1.3	.257
TTR	1.0	.326
Sex	0.6	.430
Sex*Time	<0.1	.922
MUL	1.2	.281
Sex	1.3	.262
Sex*Time	2.7	.108

Note: * Indicates statistical significance.

Table 3: Statistical Results

Lastly, we turn to RQ3. To determine the response, the difference scores were ranked from largest to smallest and using the Kendall's Tau-b and Hoeffding's Dependence coefficients, the number of concordant and discordant pairs of observations was determined and used to detect whether the gain in the concept map scores was independent of the gain in the language sample scores. All language sample scores were used in the analyses. Table 4 presents the results of the analyses. Both the NW and NDW measures show the expected association with the growth in concept map scores. Kendall's Tau coefficient also indicates an association between growth in the TTR measure and the concept map measure ($\alpha = .05$). The Hoeffding's D analysis is more conservative than the Kendall's D as can be seen by the magnitude of the correlations. Hoeffding's D more strictly controls for tied pairs and has a more well-defined distribution.

	Kendall's Tau		Hoeffding's D	
	Tau	***p***	**D**	***p***
Rank NW	.460	<.001*	.131	<.001*
Rank NDW	.417	<.001*	.102	<.001*
Rank TTR	.215	.053	.005	.234
Rank MUL	-.013	.907	-.007	.698

Note: * Indicates statistical significance.

Table 4: Coefficients of Association Results

6 Discussion and Conclusions

Our findings suggest that, on average, girls' writing samples scored higher than that of boys' at pretest. However, the findings did not suggest any initial differences in boys' and girls' pretest language measures and resulting concept map scores. Children, on average, made pretest to posttest gains in concept map scores and NW and NDW language scores. and the gains were not differentiated by gender. Finally, gains made on concept map scores were associated with gains in NW and NDW but not with MUL.

The number of utterances (sentences or independent clauses) increased over time. At pretest, the average number of utterances was 18 with standard deviation of 9.8 and, at posttest, the average number of utterances was 27 with standard deviation of 6.8. The number of utterances accounts for the increase in the NW and the expansion of the topic accounts for the increase in NDW. The number of utterances in these samples is the same as the number of questions asked and the number of responses made by the children. Increase in utterance necessarily increases NW. Concept maps are created from the different words used in the language sample, thus, the relationship between the growth in NDW and the growth in concept map scores was anticipated. At posttest, the children talked about two facets of physical health, body parts associated with the five senses and healthy habits rather than just the five senses component of physical health. The TTR and MUL measures somewhat control for the confounding aspects of the interviews. The measures of association, because of the use of ranks, indicate whether or not the high ranking scores remained ranked as high for both measure. This was not evident for the MUL growth relative to the concept development as measured by the concept map scores.

Using the class concept map to prompt children's responses has two disparate effects. We have previously found that children with low initial status demonstrate more knowledge when using a concept map to prompt their memory while children with higher initial status are constrained by the use of a concept map (Hunter, Wehry, & McLemore, 2010). Using the class concept map during the interview often prompted one or two word responses, especially at the end of the longer interviews. Short responses suppress the MUL measure, and some children developed a set response pattern in the longer, second interview. Both activities elicit concept knowledge, but suppress language scores.

In our analyses, we ignored that the scores of the individual children were not independent as they learned together in classes. The interviews were collected by school and class, so that in the process of transcribing and scoring the children's language samples, we read the transcriptions by class. Language patterns particular to classes soon emerged. Children in the same classed mimicked the language of their teachers, thus, revealing a lot about instruction and the teacher's language modeling. Some classes of children responded using complete sentences while others were content to use just one word. Possible misconceptions also emerged from the language samples. For instance, children in several classes told us that the purpose of the heart is to help with breathing. Without knowing exactly how the teacher explained the function of the heart, we cannot determine whether this is a misconception or children's simplification of the teacher's explanation.

Future work involves finding ways to separate the measure of concept and language development. We do not think that one language sample adequately serves both purposes. However, two interviews, one used to create concept maps and the other to assess language, must address the same content knowledge. Otherwise, we untangle one issue by creating another confounding issue. We also need to standardize the interview by using a script. To overcome the ceiling effect with the writing samples, we need to collect data earlier in the academic year. Once we overcome these issues, we hope to collect a large enough sample to use hierarchical linear models, thus accounting for dependency in the children's scores.

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