Concept Maps: Making Learning Meaningful
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CONCEPT MAPPING FOR PLANNING AND INSTRUCTION IN A CHILDCARE SETTING

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Abstract. The purpose of this paper is to detail the processes and procedures for incorporating concept mapping into instructional planning and implementation in four classrooms in a childcare setting (n=32). Nonfiction books and hands-on materials were used to build children's background knowledge and vocabulary in the health domain. Assessments at three points during the instructional period provided information that could be used to focus instruction. Concept maps were created based on interviews with the children. The maps were then scored by staff experienced in the scoring protocol validated previously by institute staff. Results of analyses indicated that Assessment 1 vocabulary was correlated to the final assessment results. Discussion of findings and recommendations for further research are presented.

1 Introduction

Recent research has focused on the importance of definitional or academic vocabulary in improving children's background knowledge and reading comprehension (Hirsch, 2006; Neuman & Celano, 2006; Marzano, 2004; Beck, McKeown & Kucan, 2002). In addition, it has been posited that explicit instruction in vocabulary must begin in early education years to combat the academic achievement gap that has persisted as children of poverty progress through primary education years. The achievement gap has manifested itself in what has been called "fade out" by grade three (Hirsch, 2003; Kauerz, K., 2006)

Over the past several years, staff at a research institute in the southeastern United States has developed and implemented two units of instruction for 3- and 4-year-old children who live in high-needs neighborhoods. The units focus on introducing science content by using nonfiction books. Through informational texts, the children have been taught basic science concepts related to plants and butterflies in one unit and health in the other. Another aspect of using informational texts is to enable teachers, many of whom do not have a college degree, to acquire basic understanding of the informational content. Concept mapping has been used to help the teachers plan the instruction and focus on the importance of using advance organizers to facilitate young children's knowledge acquisition in science (Zimmerman, 2005). Concept maps have also been used to enable the children to make connections among the concepts being taught and to assess their understandings (Figueiredo, M., Lopes, A. S., Firmino, R., & deSousa, S., 2004).

This paper details the processes and procedures used to implement a health-related unit of instruction during Spring 2009 in four classrooms in an urban childcare setting. Results of analyses and samples of concept maps of the children's interviews are presented.

2 Goals

The focus of the *Encouraging Healthy Habits through Literacy (Healthy Habits)* unit was to use a three-prong approach to combat the rise in childhood obesity/overweight through prevention, intervention, and community outreach activities. The program was designed to address three goals: 1) improve students' overall physical status (physical fitness), 2) improve students' overall nutritional status (nutrition education), and 3) improve families' understanding of nutrition education and physical activities to combat childhood obesity (family education).

3 Research Questions

To address the effectiveness of the planning and instructional activities, institute staff designed an assessment protocol

similar to that of Figuerdo et al. (2004). Assessment 1 was an expressive vocabulary measure using pictures related to being healthy as items. Assessment 2 used an open-ended question (without visual prompts) asking children to express what they knew about being healthy. Assessment 3 was the same open-ended question used in Assessment 2, but the child was provided a visual prompt, the class concept map. Research questions included the following:

1. Do Assessment 2 scores correlate with Assessment 3 scores?
2. Is there a difference between the Assessment 2 scores of 3-year olds and 4-year on?
3. Is the Assessment 1 score predictive of Assessment 2 score?
4. Is the Assessment 1 score predictive of Assessment 3 score?

4 Methodology/Approach

4.1 Teacher Training

Institute staff provided a training session for the childcare teachers (n=4) to acquaint them with the procedures for creating concept maps. Sample concept maps were shared and discussed with the teachers. Relevant pictures were provided to facilitate the construction of class concept maps. Teachers' initial concept maps were more generalized nonlinguistic representations, like descriptive pattern organizers and concept pattern organizers (Marzano, R. J., Pickering, D. J., & Pollock, J. E., 2001). These representations did not include propositions or a hierarchy.

Assisting childcare staff in constructing concept maps that include propositions involved a scaffolded process. For example, staff members were shown video clips of (a) a teacher engaging young children in conversations about a focus concept by posing a focus question and then using pictures to represent the connections expressed by the children, and (b) a teacher using post-it notes to capture the concepts named by the children during a classroom discussion. Institute staff was on site to assist with this process. In addition, the basic strands of the concept map that was created using the relevant pictures were enlarged to facilitate class discussions among the teachers and children (Figure 1).

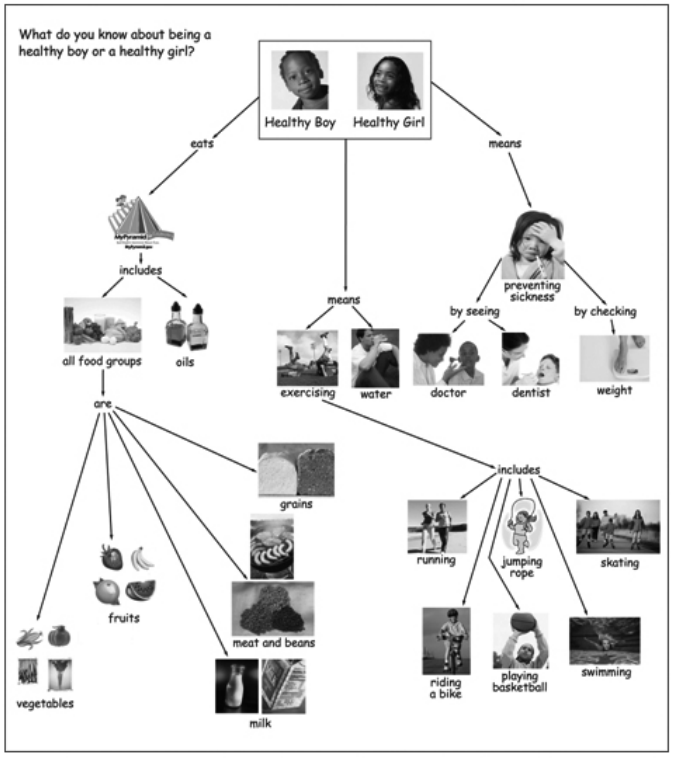


Figure 1. Healthy Habits concept map.

4.2 Components of the Curriculum

The core curriculum used was *Color Me Healthy*, developed at North Carolina State University in cooperation with the North Carolina Cooperative Extension agency and the North Carolina Division of Public Health. *Color Me Healthy* consists of 14 lessons to develop children's understanding of the importance of diet and exercise in maintaining a healthy weight. To enhance the curriculum, institute staff identified relevant and appropriate nonfiction books and lesson extensions to accompany the *Color Me Healthy* curriculum. Additionally, movement DVDs were created that correlated to the content of the curriculum.

Implementation at an urban childcare center began in January 2009 with the teacher training component. During the training, teachers were provided with the Color Me Healthy curriculum kits, sets of nonfiction books on nutrition, and the lesson plan format that had been revised from a partial implementation at another urban childcare center. They also received materials for hands-on activities, e.g., plastic foods for sorting and grouping, parachute for exercise, food pyramid pocket chart and cards, etc. Project implementation was scheduled for February 23 through April 30; however, the ending date was moved to June 12 because of other curriculum needs.

4.3 Assessment

The project director provided on-site assistance on a regular basis by attending most weekly teachers' meetings with the center's director. Additionally, the project director conducted assessments as follows: 1) Assessment 1 (late February and early March); 2) Assessment 2 (mid June); and 3) Assessment 3 (late June). In Assessment 1, the children (n=32) were given pictures of children engaged in various activities as well as pictures of food and medicine. The prompt for them to tell what they knew about the pictures was, "Tell me what you know about being healthy." For Assessment 2, children were not provided any pictures to stimulate their thinking. Their prompt was the following, "Think about the pictures and books Ms. has read and discussed about being healthy. Tell me what you know about being healthy." This assessment was designed to examine connections children were able to make about the concepts that had been taught without pictures to prompt their thinking. Samples of maps and scores from both age groups appear in Figure 2.

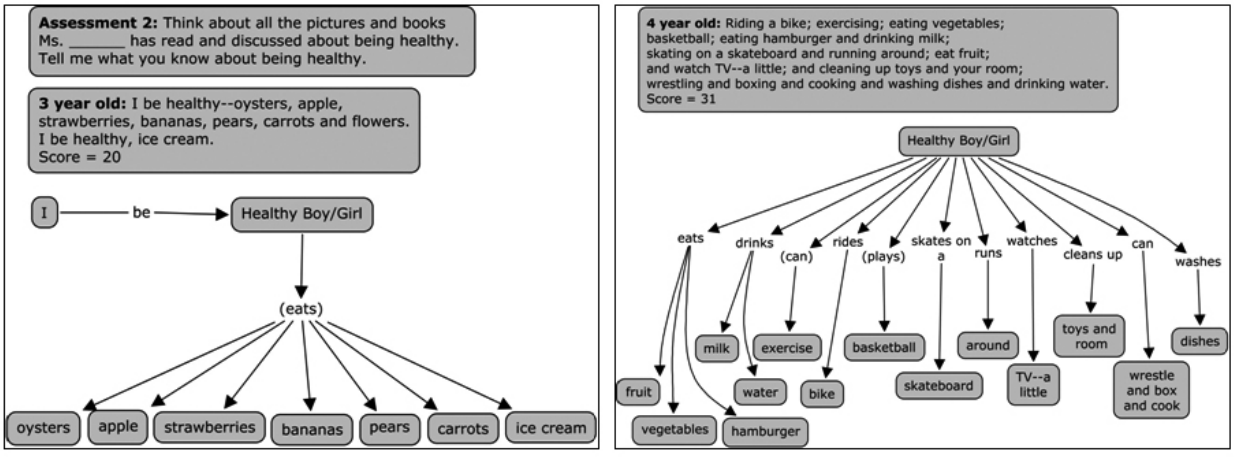
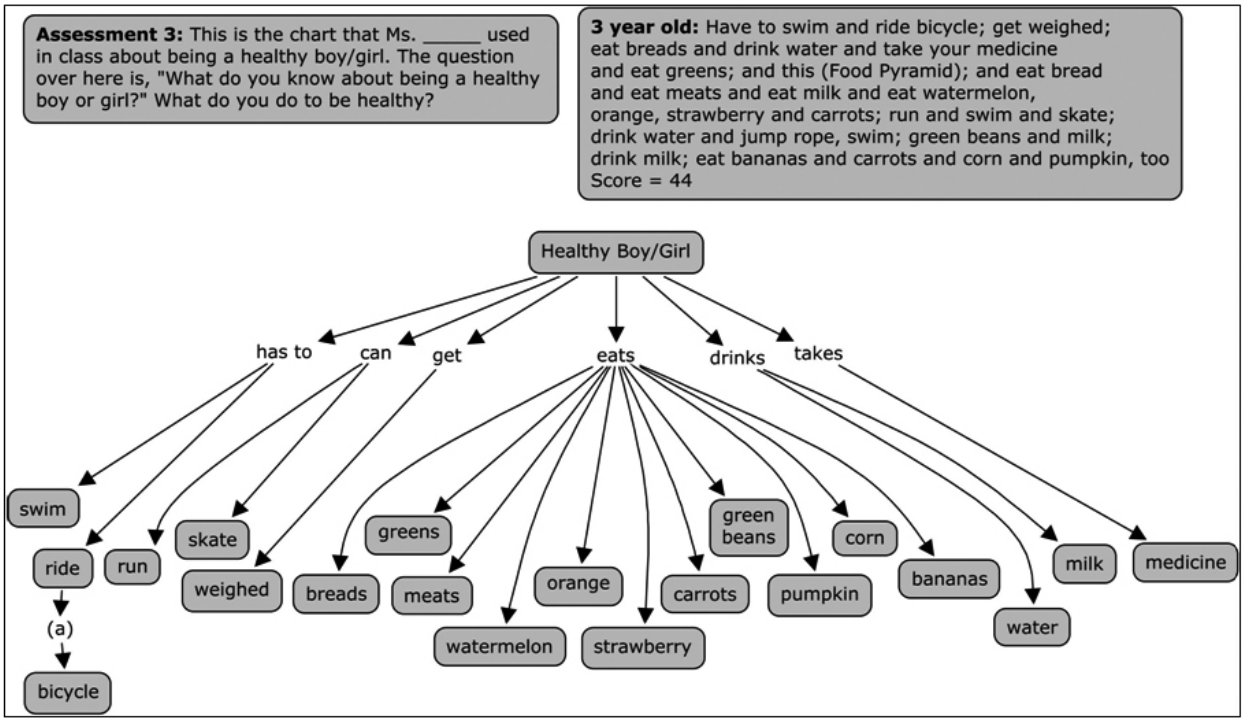


Figure 2. Assessment 2 concept maps for 3- and 4-year old children. (Concept maps were created from children's interviews.)

For Assessment 3, the children were provided the class concept map and the prompt, "This is the chart that Ms. used in class about being a healthy boy/girl. The question over here is, 'What do you know about being a healthy boy or girl?' What do you do to be healthy?" This assessment protocol was adapted from Figuerdo et al. (2004). Assessment 3 scores were used to compare the children's concept connections with and without the concept map to stimulate their thinking. Samples of maps from both age groups appear in Figure 3.



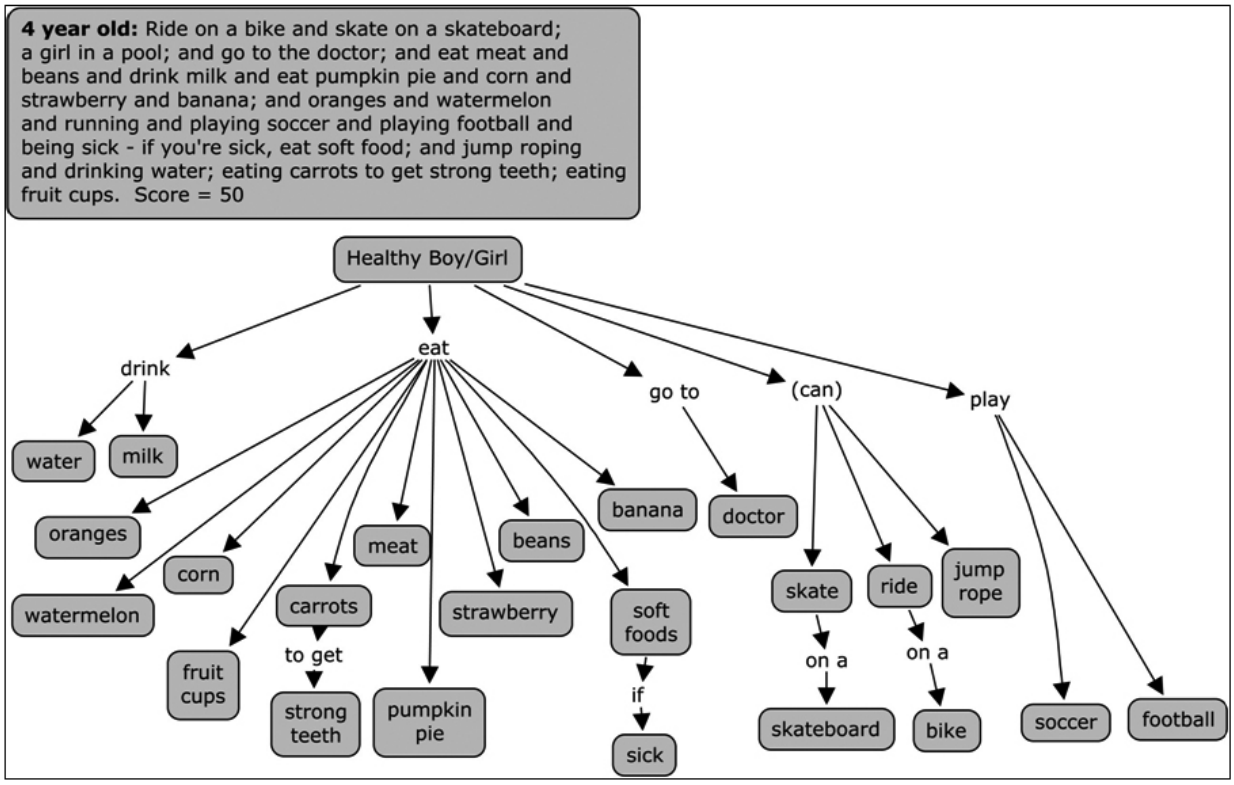


Figure 3. Assessment 3 concept maps for 3- and 4-year old children.

5 Results

Project researchers interviewed individual children and transcribed their responses. Concept maps were constructed from the transcripts by researchers experienced in reliably creating and scoring concept maps from interview transcripts (α=.95; Wehry, Algina, Hunter, & Monroe-Ossi, 2008). See Figure 4 for an example of constructing concept maps and scoring them.

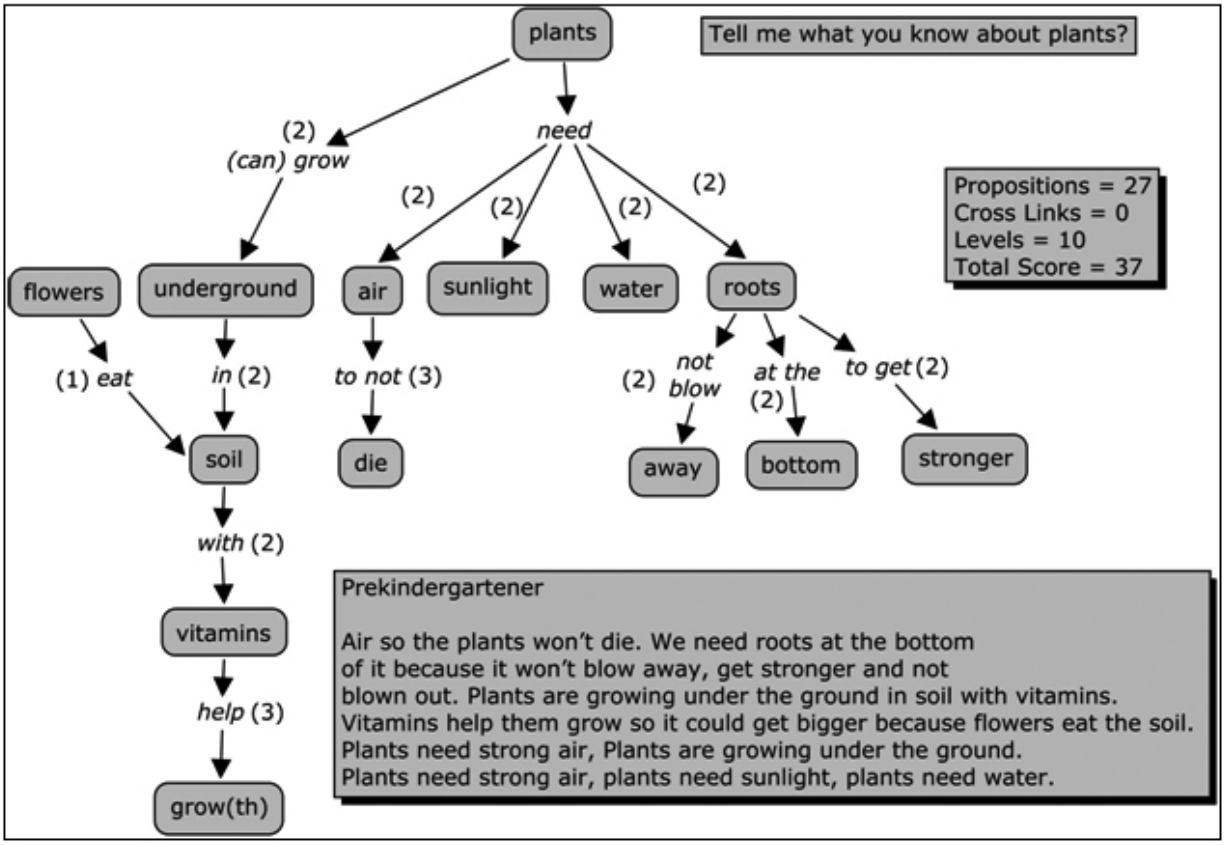


Figure 4. Example of a child's interview, the subsequently constructed concept map, and concept map score

Analysis of the concept maps to determine the number of strands mentioned by the children revealed that ten 3-year olds cited only one strand—either food (n=9) or exercise (n=1) during Assessment 2 (See sample map in Figure 2). However, at Assessment 3, with the class concept map for support, eleven 3-year olds (64%) made connections about the three major strands (food, exercise, and wellness); six of those children were also able to make the connection to the need to drink water as a factor in being healthy (Table 1).

In contrast to the results for 3-year olds, the strand analysis for 4-year olds revealed that on Assessment 2, nine children were able to cite connections about two or more strands without the aid of pictures (See sample map in Figure 2). With the class concept map for reference, 11 children (73%) were able to make connections about the three major strands; eight of those also identified the need for water, especially when exercising (Table 1).

	Number of Responses			
	3-Year Olds (*n*=17)		4-Year Olds (*n*=15)	
	Assessment 2	Assessment 3	Assessment 2	Assessment 3
Food (F)	9	0	5	0
Exercise (E)	1	0	1	0
F and E	1	3	2	1
F and Drink (D)	3	0	4	0
F and Wellness (W)	2	0	0	0
F,E, and D	0	3	2	3
F,E, and W	1	5	0	3
F, W, and D	0	0	1	0
F, E, W, and D	0	6	0	8

Note. F = Food; E = Exercise; D = Drink; and W = Wellness

Table 1. Strands (Food, Exercise, Drink, and Wellness) Mentioned by 3- and 4-Year-Old Children at Assessments 2 and 3

The mean scores of the children on the various assessments revealed that in all cases, prekindergarten children, on average, scored higher than 3-year-old children. The 4-year-old Assessment 3 scores ranged from a low of 24 to a high of 74 points. The scores for 3-year olds ranged from a low of 17 to a high of 58 points (See Table 2).

Time	*n*	*M*	*SD*	*Min*	*Max*
Assessment 1					
All	33	7.45	6.63	0.00	22.00
4-Year Olds	16	11.88	6.23	2.00	22.00
3-Year Olds	17	3.29	3.69	0.00	14.00
Assessment 2					
All	33	29.33	14.59	2.00	61.00
4-Year Olds	16	36.56	15.17	12.00	61.00
3-Year Olds	17	22.53	10.42	2.00	41.00
Assessment 3					
All	32	40.94	12.05	17.00	74.00
4-Year Olds	15	45.20	13.93	24.00	74.00
3-Year Olds	17	37.18	8.90	17.00	58.00

Table 2. Summary Statistics for Assessment 1, Assessment 2, and Assessment 3

5.1 Results: Research Question 1: "Do Assessment 2 scores correlate with Assessment 3 scores?"

To address Research Question 1, a correlation analysis was conducted (See Table 3). As expected, assessments at each time were correlated with assessments at the other times. However, not expected was that Assessment 3 was more highly correlated with the Assessment 1 (.63) than with Assessment 2 (.46) which occurred closer in time.

	Assessment 2	Assessment 3
Assessment 1	.44 (*.01*)	.63 (*<.01*)
Assessment 2		.46 (*<.01*)

Note. Italicized numbers are *p*-values.

Table 3. Correlations of Assessment 1, Assessment 2, and Assessment 3

5.2 Results: Research Questions 2 and 3: "Is there a difference between the Assessment 2 scores of 3-year olds and 4-year olds?" and "Is the Assessment 1 score predictive of Assessment 2 score?"

Our Analysis of Variance (ANOVA) statistical model explained 25% of the total variance in the Assessment 2 scores. In this model, we tested the hypothesis that the Assessment 1 and the children's age determined by their placement in preschool or prekindergarten class were not predictive of the Assessment 2 score. The 3-year-old children scored, on average, 10 points less on Assessment 2 than did 4-year-old children (See Table 4). The children's Assessment 1 ability to describe pictures did not predict their ability to recall information and form propositions without the aid of visual clues.

	Estimate	*Standard Error*	*t*-value	*p*-value
Intercept	31.30	6.33	4.94	<.001
3-Year Old	-10.23	5.98	-1.71	.098
Assessment 1	0.44	0.45	0.97	.341

Table 4. ANOVA Results for Assessment 2

5.3 Results: Research Question 4: "Is the Assessment1 score predictive of Assessment 3 score?"

To address Research Question 4, we began with a simple ANOVA model that included only the Assessment 1 and the children's age as 3-year-old preschoolers and 4-year-old prekindergarteners as predictors. As expected, based on the estimated correlations shown in Table 3, the Assessment 1 was predictive of the Assessment 3 scores, and when controlling for initial achievement, the preschooler's mean score was almost three points higher than the prekindergarteners' mean score. To more fully address the Research Question, we added Assessment 2 scores and possible interactions to the model. The final model explained 55% of the total variance in the Assessment 3 scores (See Table 5).

	Estimate	*Standard Error*	*t*-value	*p*-value
Simple Model				
Intercept	29.88	4.81	6.22	<.001
3-Year Old	2.79	4.48	0.62	.539
Prekindergarten	0.00			
Assessment 1	1.37	0.37	3.73	<.001**
Final Model				
Intercept	14.19	6.72	2.11	.044
3-Year Old	19.16	8.10	2.37	.026
Prekindergarten	0.00			
Assessment 1	1.27	0.33	3.84	<.001**
Assessment 2	0.48	0.16	3.04	.005
3-year* Assessment 2	-0.49	0.26	-1.90	.069*
PreK*Assessment 2	0.00			

Note. *$p < .10$. **$p < .01$.

Table 5. ANOVA Results for Assessment 3

Results of the final model indicate that the main effect of Assessment 1 score was not involved in an interaction; therefore, the straight-forward interpretation of the results is that every word identified at Assessment 1 predicts a 1.27 increase in the Assessment 3 score. The main effect of Assessment 2 and the child's placement as 3- or 4-year-old is confounded (p-value = .069); therefore, interpretation of the simple main effects could be misleading. The results in the table indicate the following equations for predicting Assessment 3 for prekindergarten and preschool children.

$$\text{Assessment 3} = 14.19 + 1.27(\text{Assessment 1}) + 0.48(\text{Assessment 2})$$

for 4-year-old children, and

$$\text{Assessment 3} = 14.19 + 19.16(1(\text{for 3-year-olds})) + 1.27(\text{Assessment 1}) + 0.48(\text{Assessment2}) - 0.49(\text{Assessment2})$$

for 3-year-old children.

The equation for the 3-year-old children simplifies to

$$\text{Assessment 3} = 33.35 + 1.27(\text{Assessment 1}) - .01(\text{Assessment 2})$$

Thus, for children with the same Assessment 1 score, when the 3- and 4-year olds' Assessment 2 score is near zero, the 3-year olds' Assessment 3 score is 19 points higher than that of the 4-year olds'. However, the difference between 3- and 4-year olds' Assessment 3 score decreases as the Assessment 2 score increases, and when the Assessment 2 score of both groups of children approaches 38, there is no difference in the Assessment 3 score of preschool and prekindergarten children who have the same Assessment 1 score.

6 Summary

Data analyses indicated that Assessment 1 was more highly correlated with Assessment 3 than was the more proximal Assessment 2. This finding can most likely be explained by the modality of the assessments with Assessment 3 using the same or similar visual prompts as Assessment 1. Furthermore, during Assessment 2, children's responses were not constrained or limited by the set of pictures, but rather the children were free to talk about all of the conceptual connections they made about being healthy. Results also indicated that 3-year olds' Assessment 2 mean score was lower than that of the 4-year olds' and that Assessment 1 predicted Assessment 2 for both groups of children. This finding was expected as, on average, the 3-year olds' initial expressive vocabulary was between 3 and 4 words while the 4-year olds' initial expressive vocabulary was between 11 and 12 words. That this differentiation was maintained at Assessment 2 was expected; however, both groups showed the same level of improvement. The results of the analysis of final model of Assessment 3 predictors were unexpected. The difference in the predictive power of Assessment 2 relative to Assessment 3 can possibly be explained by the 3-year olds' initial lower expressive vocabulary scores; however, 3-year olds with high initial status had Assessment 3 scores similar to 4-year olds. When both preschool and prekindergarten children had low initial status, the 3-year olds outperformed the 4-year olds on Assessment 3. Finally, study findings should be cautiously considered because of low statistical power due to the small sample size and of the lack of generalizability due to the one childcare center context. However, the findings do suggest areas for further research.

Assessment 3 results tend to reinforce that providing a means for dual coding (Paivio, 2006), in this instance the class concept map with pictures and words and the reading of content related text, can enable young children "to read" the map and provide information about connections made during the instructional unit. Also, the finding that Assessment 1 score was predictive of Assessment 3 provides further evidence of the need to emphasize vocabulary and content learning in the early education years.

Through this implementation, the utility of concept maps to capture children's thinking was evident. In addition, the results provide insight into both training teachers to use concept maps and how to use the results to inform instruction.

7 Acknowledgement

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