Concept Mapping: Connecting Educators
Proc. of the Third Int. Conference on Concept Mapping
Tallinn, Estonia & Helsinki, Finland 2008

HEALTHY HABITS THROUGH LITERACY: A CONCEPT MAPPING AND HEALTH CURRICULUM FOR PRESCHOOL AND PREKINDERGARTEN CHILDREN

Heather Monroe-Ossi[1], Stephanie Wehry[1], James Algina[2], & Janice Hunter[1]
[1] Florida Institute of Education at the University of North Florida, Jacksonville, Florida, USA
[2] University of Florida, Gainesville, Florida, USA
Email: h.monroe-ossi@unf.edu

Abstract. The purpose of this paper is to report on the development and implementation of the *Healthy Habits through Literacy* curriculum and to extend our knowledge of the utility of concept maps to assess the complexity of preschool and prekindergarten children's knowledge structures. *Healthy Habits through Literacy* was designed to combat the rise in childhood obesity by building the background knowledge and concept development of health related topics. The curriculum supports the goal of improving readiness outcomes for preschool children by utilizing strategies that help children develop visible thinking strategies including concept mapping. Implementation of *Healthy Habits through Literacy* afforded researchers the opportunity to develop and test a protocol for constructing concept maps from transcribed interviews of young preschool children, estimate the associations of concept map scores and measures of vocabulary development and school readiness, and to extend our knowledge of the utility of concept map scores to quantify the represented knowledge structures of 3-year-old preschool children. The estimated reliability for mapping and scoring the transcribed interviews was .95. The children's concept map scores were positively associated with their standardized achievement scores on the EVT-2 (.29) and the BBCS-3:R Self-/Social Awareness scores (.49).

1 Introduction

Concept mapping has been successfully used to assess science curricula and in particular to assess science curricula implemented in preschool settings. The purpose of this paper is to extend the investigations of the use of concept mapping with young children and the reliability and validity of the use of concept map scores to quantify the complexity of young children's knowledge reported in the work of Figueiredo, Lopes, Firmina, and de Sousa (2004) and Wehry, Algina, Hunter, and Monroe-Ossi (2008). Figueiredo et al. used concept mapping in a rural setting in Spain to assess young children's knowledge of cows. Wehry et al. developed and investigated the reliability of a scoring system used to quantify concept maps constructed from transcribed oral responses to interviews of the young children experiencing the *Young Florida Naturalists* curriculum. This study will extend their work to the *Healthy Habits through Literacy* preschool curriculum which focuses on nutrition and physical fitness. We evaluated a protocol for use when constructing concept maps from children's transcribed interviews, extended the reliability study of the scoring system to the new curriculum, investigated associations of concept map scores and achievement, and extended our knowledge of the utility of concept maps to even younger preschool children.

Neuman (2006) pointed out the importance of children's knowledge relative to their early literacy achievement, but noted there has been little discussion of the differences in children's content knowledge as it relates to that achievement. She posited that this lack of knowledge leads to reading comprehension difficulties because the gap existing between the knowledge of children who live in poverty and those who do not widens as the children become older. Moreover, many current efforts to close the achievement gap focus on skill development in isolation from meaningful content. Siegler (2001) emphasized that the central connection between instruction and cognition is learning and, furthermore, that we can teach children to pursue meaning thereby increasing the probability that they will seek meaning. Advances in cognitive science show that learning to learn is a skill that can be learned.

The more one knows about a topic the better one understands, learns, and remembers new information about that topic. The *Healthy Habits through Literacy* curriculum proposes that the development of intentional thinking requires that teachers provide learning opportunities that introduce ambiguity in the content. Through this type of instruction, learning possibilities are open and lead to *mindfulness*, a thinking disposition with three components: ability, inclination, and sensitivity (Langer, 1989, as cited in Perkins, Tishman, Ritchhart, Donis, & Andrade, 2000).

Thinking routines are "simple patterns used over and over again that support and scaffold specific thinking moves or actions" (Ritchhart, Palmer, Church, & Tishman, 2006). Thinking routines make thinking visible, promote mindfulness, and are critical for identifying students' misconceptions. Routines include questioning students when they describe their ideas. For example, asking, "*What makes you say that*?" provides children

with a useful structure to support their ideas and enables teachers to learn what children are thinking about a particular topic. Increases in students' inclination toward thinking, their awareness of opportunities for thinking, and their use of specific thinking skills help foster better understanding (Perkins, 2003).

Developing non-linguistic representation strategies such as graphic organizers, pictographs, and concept mapping relates to the importance of Paivio's (1990) *dual-coding* theory of knowledge storage. Knowledge is stored two ways, in linguistic and non-linguistic (imagery) forms. Marzano, Pickering, and Pollock (2001) found that students who used both ways to store information were more able to recall and apply knowledge. Concept maps, help children see relationships among concepts and provide a visual representation for hierarchical concepts (Novak & Gowin, 1984). The *Healthy Habits through Literacy* curriculum, designed to strengthen children's background knowledge and cognitive development, embeds explicit thinking routines. The curriculum calls for the use of concept mapping to document growth in the complexity of the children's knowledge structures. Figure 1 shows a concept map depicting the tenets of the *Healthy Habits through Literacy* curriculum.

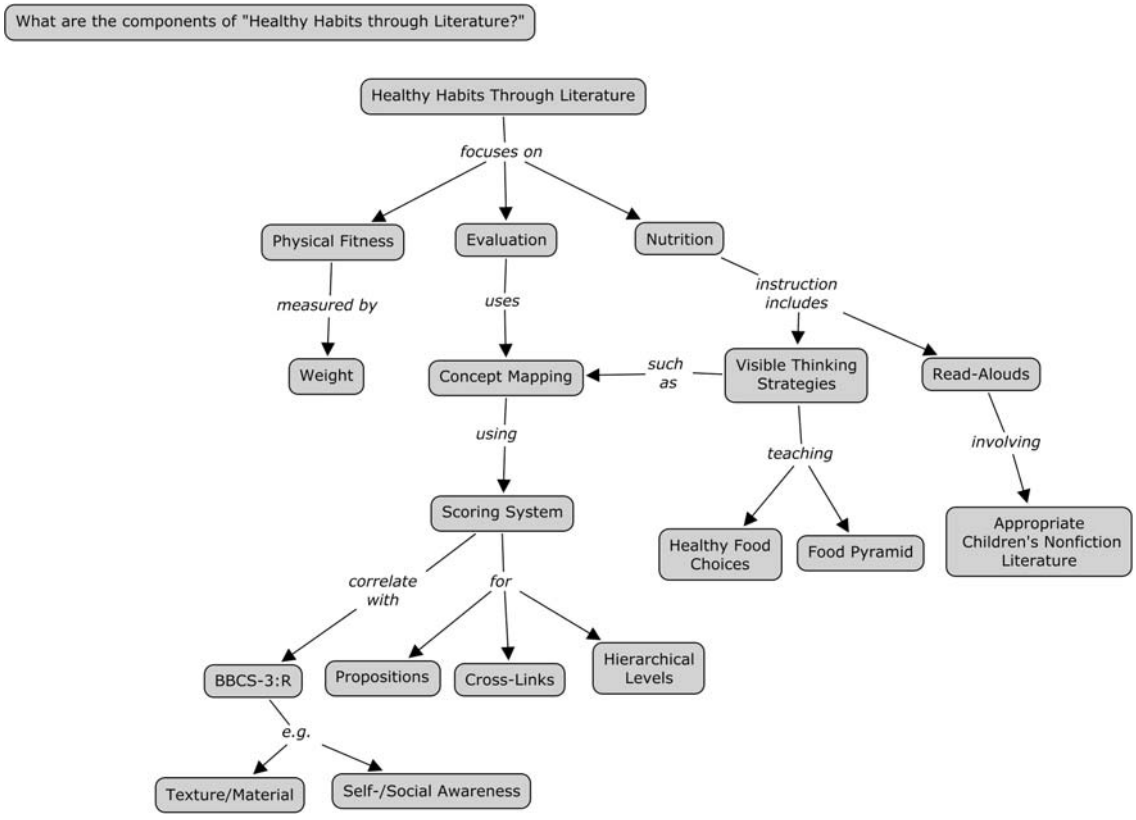

Figure 1. A concept map depicting the *Healthy Habits through Literacy* curriculum.

2 Intervention: *Healthy Habits through Literacy*

The *Healthy Habits through Literacy* curriculum focused on four goals. The first goal was to increase young children's knowledge of the food pyramid, food groups, and healthy food choices through the implementation of the embedded *Color Me Healthy* curriculum (Dunn, Thomas, & Pegram, 2001). The second goal was to increase teachers' use of explicit instructional strategies that promote cognitive development. A third goal was to increase teachers' consistent use of non-linguistic representations that demonstrate relationships among topics through concept mapping. Finally, the fourth goal was to provide children with daily physical activities that are appropriate for preschool children.

The research team provided weekly, ongoing support to teachers through on-site coaching and professional development sessions. Prior to implementation, teachers attended a concept mapping workshop that included an overview of concept mapping, making a concept map having the focus question, "*What makes a healthy body?*" and viewing videos of preschool teachers completing a concept map with preschool children. Following the initial session, a project researcher modeled how to complete a class concept map with teachers from the participating classrooms.

Implementation of *Healthy Habits through Literacy* lessons began March 2008 and continued through May 2008. Instructional strategies included using children's literature to identify vocabulary and concept words linked to health content. Questioning strategies were used to encourage discussion among children before, during, and after readings. Visible thinking strategies such as "*What do you see, what do you think, what do you wonder?*" were embedded in the teacher-child dialogue to strengthen mindful thought. Each teacher completed an initial class concept map that visually represented the preschool children's knowledge of healthy habits prior to the implementation of the curriculum. Class concept maps were continually updated to reflect the knowledge children gained throughout the curriculum implementation.

2.1 Participants and Context

The *Healthy Habits through Literacy* curriculum was implemented at a local preschool center, serving some of the most vulnerable children who reside in a high-need, high-crime, urban neighborhood. Almost all of the enrolled children are low-SES, African-American children. The teachers of three classes enrolling approximately 55, 3-year old preschool and 4-year-old prekindergarten children implemented *Healthy Habits through Literacy* during spring 2008.

2.2 Assessing Healthy Habits through Literacy

The *Healthy Habits through Literacy* project included a pre-assessment and three additional assessments. In the pre-assessment, after listening to their teachers read a book about fitness and nutrition, the children were asked to use pictures to construct a class concept map having "*What makes a healthy body?*" as its focus question. The class concept map was displayed in the classroom and updated to reflect the children's increased knowledge structure as they progressed through the lessons.

In Assessment 1, the children were given a blank organizer for the class concept map, pictures representing the concepts on the class map, and scripted directions for completing the assessment, (*"Over the past few weeks, you have been learning about being healthy. You and your classmates organized pictures into a class concept map that showed what you have learned. I have pictures that look like the ones used on your class concept map. Let's look at the pictures I have here. This is …(identify each of the pictures). Try to remember how the pictures were connected on the concept map you made with your class. Use the pictures to show me where you think they go and how they are connected."*) Assessment 1 occurred March 19-27, 2008. Figure 2 shows the concept maps transcribed from Assessment 1 interviews of a prekindergarten child who participated in a concept mapping curriculum as a 3-year-old preschooler during the 2006-2007 academic year and the concept map of a prekindergarten child who was a novice mapper. The concept map on the left was developed from the interview of the child experienced in concept mapping. The child sorted the concepts by categories in a top to bottom fashion, provided linking words, and used all concept pictures provided. The concept map on the right was developed from the interview of the child who was a novice mapper. The novice mapper also sorted the concepts but used a horizontal display following the conventions of print in a left-to-right fashion, provided no linking words, and used only seven concepts.

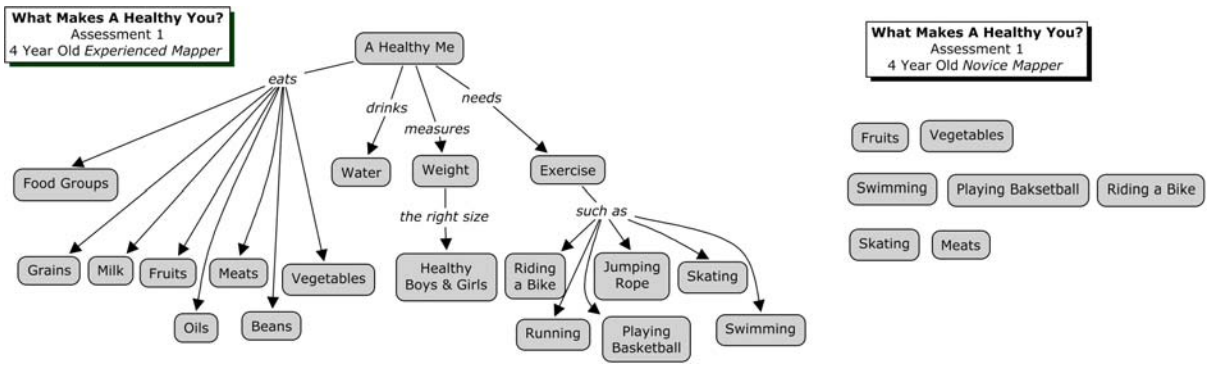

Figure 2. Concepts maps of two prekindergarten children formed as part of *Healthy Habits through Literacy* Assessment 1.

Assessment 2 was conducted April 21-29, 2008 by project researchers using a structured interview. Interview transcripts were transformed into concept maps using a mapping protocol and individual concept maps were scored using a concept map scoring system which assigns values to propositions, cross-links, and hierarchical levels. (See Wehry et al., 2008.)

Figure 3 shows the Assessment 2 concept maps of the same children featured in Figure 2. The experienced mapper's interview resulted in a fairly complex concept map structure. The novice mapper demonstrated the well-known quirkiness of children this age by not being in the mood to elaborate on being healthy.

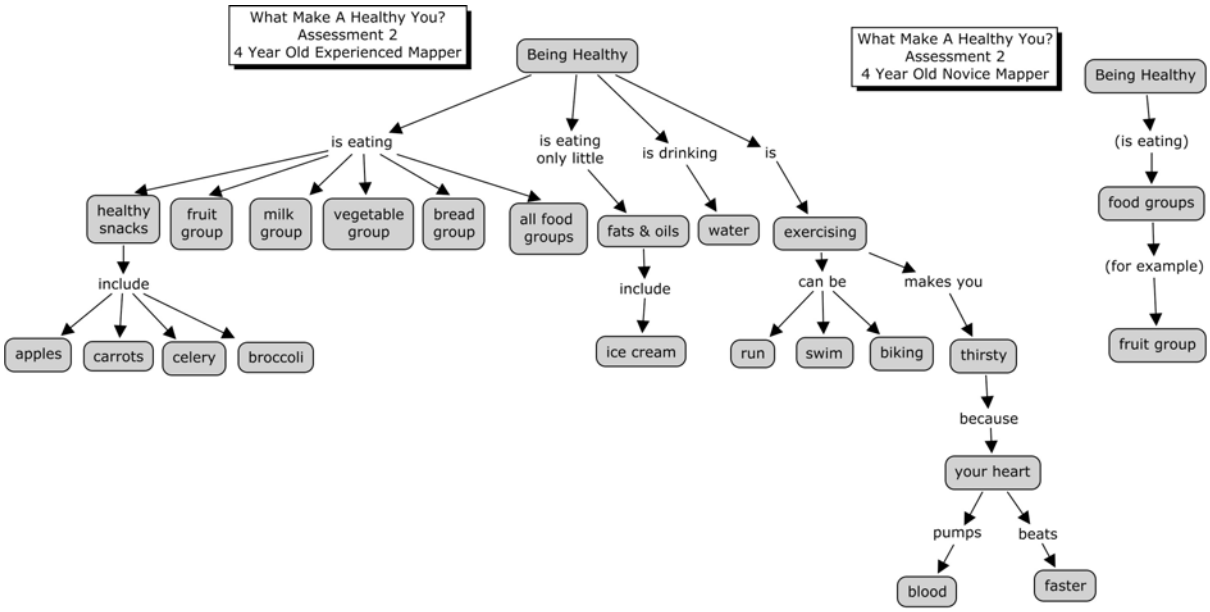

Figure 3. Concepts maps of two prekindergarten children formed as part of *Healthy Habits through Literacy* Assessment 2.

Assessment 3 was completed May 12-16, 2008 to assess children's understanding of the *Healthy Habits through Literacy* content as represented on the final, updated class concept map. Children were shown the class concept map and asked "*What do these pictures represent? This is the class concept map you did with Ms. _____. What do the pictures tell you about being healthy?*" Children were assessed individually, responses were transcribed, concept maps constructed, and scored to evaluate the complexity of the children's knowledge about nutrition and fitness.

3 Research Questions, Data Collection, and Analyses

The purpose of this study is to report the development and implementation of the *Healthy Habits through Literacy* curriculum and use results from the implementation to extend the work of Wehry, Algina, Hunter, and Monroe-Ossi (2008) which investigated the utility of young children's concept maps to quantify the complexity of their knowledge structures. Data used in this study included concept maps constructed from the Assessment 2 interviews, children's demographic information, and vocabulary and school readiness achievement test scores. Research questions include

Research Question 1: How much of the total variance in preschool children's concept map scores was accounted for by the person who constructed the concept maps from the children's transcribed interviews?

Research Question 2: Are preschool children's concept map scores differentiated by class assignment (age), and gender?

Research Question 3: Is the complexity of prekindergarten children's knowledge structures as represented on the Assessment 2 concept maps greater for children who previously experienced a curriculum that included concept mapping than for children who were experiencing concept mapping for the first time?

Research Question 4: Are measures of preschool and prekindergarten children's language development (receptive and expressive) associated with their Assessment 2 concept map scores? Are measures of preschool and prekindergarten children's school readiness (receptive and expressive) associated with their Assessment 2 concept map scores?

3.1 Data Collection and Analyses

Data used included the transcribed Assessment 2 interviews. The project research team developed a concept mapping protocol and trained three mappers to use it to form concept maps from the transcribed interviews. Concept map raters, trained to use a previously developed scoring system, scored the concept maps. Data also

included children's demographic information, an indicator of whether or not the prekindergarten children experienced the *Young Florida Naturalists* curriculum as 3-year-old preschoolers, and achievement scores. In early spring 2008, the participating children (with informed consent) were administered the Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4; Dunn & Dunn, 2007) and Expressive Vocabulary Test, Second Edition (EVT-2; Williams, 2007), Bracken Basic Concept Scale Revised: Expressive (BBCS:E; Bracken, 2006a) and Bracken Basic Concept Scale-Third Edition: Receptive (BBCS-3:R; Bracken, 2006b) as a part of a related study investigating potential differences in the expressive and receptive vocabulary measures of low-SES, African-American children. The PPVT-4 assesses children's receptive vocabulary and listening ability while the EVT2 assesses children's expressive vocabulary and word retrieval. The BBCS-3:R uses a receptive format to assess children's basic concept development—concepts which are considered necessary to early formal education, and the BBCS:E uses an expressive format to assess children's basic concept development.

4 Results

4.1 Interrater Reliability

Training in the use of the mapping protocol was provided to three researchers and training to use the scoring system was provided to three other researchers. Each of the 48 transcribed interviews was mapped by each mapper producing 144 concept maps. These maps were then each scored by the three raters. Altogether, each interview had nine concept map scores for each component and nine total scores. To examine the generalizibility of scores across raters, four person (p) by mapper (m) by rater (r) G studies were conducted for three components of the concept map score and the total score. The results of the G studies are presented in Table 1.

	Concept Map Score Types							
	Proposition Score		Cross-Link Scores		Hierarchy Score		Total Score	
Source of Variation	Estimated Variance Component	Percent of Total Variability	Estimated Variance Component	Percent of Total Variability	Estimated Variance Component	Percent of Total Variability	Estimated Variance Component	Percent of Total Variability
Person (p)	47.35	95.94	7.35	85.91	3.50	82.66	14.30	94.71
Mapper m)	0.06	0.12	0.00	0.00	0.00	0.04	0.02	0.16
Rater (r)	0.08	0.15	0.00	0.00	0.02	0.55	0.04	0.26
p*m	1.25	2.52	0.98	11.50	0.40	9.52	0.03	0.20
p*r	0.33	0.67	0.10	1.19	0.17	4.00	0.00	0.00
m*r	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
p*m*r	0.29	1.40	0.12	1.40	0.14	3.22	0.70	4.67
$\hat{\rho}^2$ relative	.96		.85		.83		.95	
$\hat{\phi}$ absolute	.96		.86		.83		.95	

Table 1: Generalizibility Study Results

The G studies indicated the interrater reliability is .96, .86, .83, and .95 for the propositions, cross-link, hierarchy, and total score, respectively. The raters contributed very little to the total variance of the concept map component scores and the total score, and the mappers contributed little to the total variance of the proposition score and the total concept map score. However, the interaction of the mappers and person (interview) accounted for roughly 10% of the variance of the cross-link and hierarchy scores. Any variation in the mapping of these aspects of the concept map results in a minimum of a 5-point difference because of the scoring system (see Wehry et al., 2008). Even though the total score has high reliability, researchers intend to review the mapping protocol to obtain better consistency across mappers. The concept map scores were averaged across mappers and raters and the resulting mean concept map score was used in the remaining analyses.

4.2 Concept Map Scores Differences by Population Subclasses

Thirty children (15 boys and 15 girls) were prekindergarteners and 18 children (11 boys and 7 girls) were 3-year-old preschoolers. Gender and class were tested in a regression to determine if there were differences in the children's concept map scores by class (age) or gender. Results of the regression are presented in Table 2.

Source of Variance	*df*	Mean Square	F ratio	*p*-value
Class	2	10.11	0.11	.8990
Gender	1	175.51	1.85	.1802

Table 2: Regression Results for Class and Gender

The children's concept map scores were not differentiated by gender or class. The adjusted mean score for girls was 21.71 and for boys was 18.00 indicating that the structure of the girls' knowledge represented on the concept maps might be more complex than the boys, but this difference was not statistically significant. The mean score of the prekindergarten children (20.39) was also slightly higher than that of the preschoolers (19.22), but, again, this difference was not statistically significant.

The 30 prekindergarteners consisted of 16 children who experienced the *Young Florida Naturalists* curriculum as 3-year-old preschoolers the previous year. A possible difference between the mean scores of these two groups of children was tested using regression. Table 3 shows the results of the regression. The scores of the prekindergarten children were not differentiated by their mapping experience; however, the experienced mappers' mean score was 21.12 and the novice mappers' mean score was 19.55.

Source of Variance	*df*	Mean Square	F ratio	*p*-value
Experience	1	18.50	0.14	.7112

Table 3: Regression Results for Concept Mapping Experience of the Child

4.3 Correlations of Concept Map and Achievement Scores

The mean concept map scores of the children were used in conjunction with the available PPVT-4, EVT-2, BBCS-3:R, and BBCS:E scores to investigate associations between concept map and achievement scores. Table 4 shows the estimated correlations between the children's concept map and achievement scores.

Test	Subtest/Score	Mean	Correlation	*p*-value
PPVT-4	standardized	91.26	.19	.26
	raw	66.63	.17	.32
EVT-2	standardized	94.54	.29	.09*
	raw	53.86	.28	.10*
Bracken Receptive	School Readiness Composite (standardized)	8.91	.19	.27
	School Readiness Composite (raw)	52.83	.19	.28
	Self-/Social Awareness (standardized)	8.34	.49	.00**
	Self-/Social Awareness (raw)	20.74	.40	.02**
	Texture/Material (standardized)	7.63	.25	.14
	Texture/Material (raw)	11.17	.20	.25
Bracken Expressive	School Readiness Composite (standardized)	10.31	.20	.24
	School Readiness Composite (raw)	42.49	.28	.11
	Self-/Social Awareness (standardized)	7.94	.23	.18
	Self-/Social Awareness (raw)	9.54	.25	.15
	Texture/Material (standardized)	7.83	.23	.18
	Texture/Material (raw)	5.20	.21	.23

Note. * indicates statistical significance at α=.10 and ** indicates statistical significance at α=.05; *n*=35.

Table 4: Correlations of Achievement Test and Concept Map Scores

Both the standardized and raw EVT-2 and BBCS-3:R Self-/Social Awareness scores were positively correlated with the children's total concept maps scores.

5 Discussion

The *Healthy Habits through Literacy* project was successfully implemented in three classes at one child care center. The children's knowledge of the food pyramid, food groups and healthy choices increased. The *Healthy Habits through Literacy* curriculum did not involve the level of hands-on experiences found in the *Young Florida Naturalists* project and the focus topic of *Healthy Habits through Literacy* was more abstract for the

children than in the *Young Florida Naturalists* project. The average concept map score, 19.91, for *Healthy Habits through Literacy* was also lower than the average score for *Young Florida Naturalists*, 22.55. The *Healthy Habits through Literacy* interviews were more often than not lists of healthy foods the children liked to eat. The research team plans to revise the curriculum to include more hands-on experiences that will hopefully allow the children to make more cross-links.

The research team is working to develop a mapping protocol and scoring system that can be used for both formative and summative evaluation across curricula in preschool settings. Therefore, the mapping protocol needs revision to strengthen the consistency among mappers. The simple interviews involving lists of food were mapped with consistency; however, consistency was less apparent as the complexity of the interview increased. Since complexity shows up in the cross-links and hierarchy levels, it is not surprising that the mapper by interview (person) interaction variance was large. The research team plans to refine the mapping protocol and conduct a new generalizibility study. The use of the scoring system contributed little to the total variance in the map scores across both the *Healthy Habits through Literacy* and the *Young Florida Naturalists* projects.

Differences found in the concept map scores of boys and girls in the *Young Florida Naturalists* project were not replicated in this study; however, the point estimate of the girls' mean score was higher than the boys'. What was more surprising is the finding of no difference in the concept map scores of the 3-year-old preschoolers and the prekindergarten children who were a year older. One possible explanation for this is the abstract nature of the focus and that interviews from both groups of children consisted mostly of lists of food.

Similarity to *Young Florida Naturalists* findings, the BBCS-3:R Self-/Social Awareness scores were positively correlated with the children's total concept map scores. However, the BBCS-3:R Texture/Material scores were not associated with the children's concept map scores. The Self-/Social Awareness scale assesses person-oriented knowledge. Inspection of the scale items shows that children were asked to select pictures that correspond to named attributes of people and/or relationships among people. The Texture/Material scale assesses children's knowledge about the attributes of objects in their environment. *Healthy Habits through Literacy* focused on self rather than objects, so this finding was not surprising.

Given that a goal of the project was to promote cognitive development, the positive correlation between the children's vocabulary measure, EVT-2, and concept map score is important. Note, however, the children's scores on the PPVT-4, the more widely used measure of vocabulary, were not associated with their concept map scores. But the reverse was found for the Bracken scales where scores from the receptive and not the expressive scale were correlated with the children's concept map scores. More research is needed on the use of receptive and expressive measures when assessing young, low-SES, African-American children.

5.1 Implication for Practice

Novak and Musonda (1991), in a study that constructed concept maps from young children's transcribed interviews, found that rating the interviews did not provide clarity when determining the structure of the children's knowledge relative to the entire domain. However, construction of concept maps allowed the respondent's propositions to be arranged in a hierarchical form and cross-links illustrated. Our experiences with preschool children's concept maps similarly showed that their maps could be useful as formative assessments. It was through constructing concept maps from the children's interviews that we first noticed the children had knowledge of the food pyramid and the food groups and could list healthy foods they liked to eat. However, most of the children did not place their list of healthy foods within food groups. Most complexity of the maps was expressed as hierarchical levels not cross-links. A suggestion for curriculum revision might be to develop sorting tasks where children sort pictures of foods into food groups.

5.2 Further Research

Avenues for future research include redesigning *Healthy Habits through Literacy* to develop hands-on activities for the children and developing more curricula designed to promote children's cognitive development. The concept mapping protocol needs to be refined to obtain more consistency when mapping cross-links and hierarchical levels. This study demonstrated concept mapping curricula, scoring, and associations with achievement could be extended downward to include 3-year-old preschoolers—the next steps will extend concept mapping curricula upward to include prekindergarten and kindergarten children.

6 Acknowledgment

Development and implementation of the *Healthy Habits through Literacy* project was made possible through funding provided by a grant from the UNF Foundation at University of North Florida.

Development and implementation of the *Young Florida Naturalists* project was made possible by funding provided by a grant from the Environmental Center at the University of North Florida.

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