

YOUNG FLORIDA NATURALISTS: CONCEPT MAPPING AND SCIENCE LEARNING OF PRESCHOOL CHILDREN

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Abstract. The *Young Florida Naturalists* project focused on increasing the background knowledge and concept development of 3- and 4-year-old children (n = 53) enrolled in three classes at an early learning center. This study built on the work of Hirsch (2006), Neuman & Celano (2006), Novak & Gowin (1984), and Zimmerman (2005) regarding concept mapping, elementary science learning, and the knowledge gap of at-risk, young children. Learning experiences involved plants and their role in the environment. Instructional activities included advance organizers or statements of scientific beliefs to guide the children's investigations. Investigations included activities such as determining the effects of sunlight on plant growth. Building background knowledge was emphasized as the children engaged in concrete experiences with plants in a butterfly garden developed on the center's grounds. Vocabulary development was emphasized through read-aloud activities based on environmental books purchased with grant funds. Concept mapping was used to document the hierarchical relationships described by the children before, during, and after learning experiences were initiated.

1 Introduction

Several areas have been highlighted in research on literacy development, development of scientific thinking, and cognitive development. In the area of literacy development, it has been found that vocabulary growth and language expansion occur through reading aloud to children (Lyon, 2001). In the area of development of scientific thinking, Zimmerman (2005) conducted an extensive review of research. She reported that young children tend to ignore evidence that conflicts with prior beliefs and that advance organizers are essential to effective science teaching with young children. Concept mapping has been documented (Novak & Gowin, 1984) as a strategy for examining children's understanding of relationships among concepts. Through concept mapping children are able to make visible their thinking about the relationships among the concepts being studied. With these findings in mind, the *Young Florida Naturalists* project focused on the following: a) using read aloud strategies to reinforce vocabulary and concept development, b) providing advance organizers to frame experiments involving plants, and c) initiating concept mapping to capture children's thinking about the relationships among the concepts. Hirsch (2006) and Neuman & Celano (2006) indicated that for children to become proficient readers, they must possess broad knowledge that enhances comprehension. Many at-risk, young children enroll in kindergarten with what has been described as a knowledge gap. They have not been exposed to experiences that have enabled them to develop broad background knowledge across content areas when compared to middle-class peers. This project was designed to enable young children to build core knowledge essential to becoming proficient readers.

2 Method

The *Young Florida Naturalists* project focused on three goals. The first goal was *to increase young children's knowledge of plants and their role in the environment*. The second goal was *to introduce scientific learning through hands-on instructional experiences*. The third goal was *to examine the utility of concept mapping as a tool to track concept development in at-risk young children (3- and 4-year-olds)* and is, therefore, focused on how young children learn. Through these goals the proposed project addressed a city-wide goal to have all children enroll in kindergarten, "ready to read, ready to learn, and ready to succeed."

2.1 Objectives

The objectives of the *Young Florida Naturalists* curriculum were the following:

- Enable young children to correctly identify concepts and their hierarchical relationships by providing environmental experiences with plants.
- Enhance vocabulary development and language expansion of young children by reading selected books to them.
- Help children develop concept maps based on their statements about plants and the environment.
- Help scaffold children's thinking about plants and their relationship to the environment by using advance organizers as an instructional tool.
- Help young children develop conceptual thinking by providing opportunities to construct concept maps using word/picture cards.

2.2 Hypotheses

The hypotheses were as follows:

Young children will not be able to articulate the hierarchical relationships among the concepts related to plants and their role in the environment.

Young children will not be able to construct a concept map that includes second or third level concepts, related to plants in the environment.

2.2 Participants and Context

The *Young Florida Naturalists* project focused on increasing the background knowledge and concept development of 3- and 4-year-old children (n = 53) enrolled in three classes at an early learning center located in a high-need, urban neighborhood. This study built on the work of Hirsch (2006), Neuman & Celano (2006), Novak & Gowin (1984), and Zimmerman (2005) regarding concept mapping, elementary science learning, and the knowledge gap of at-risk, young children. Learning experiences involved plants and their role in the environment. Instructional activities included advance organizers or statements of scientific beliefs to guide the children's investigations. Investigations included activities such as determining the effects of water, sunlight, air and soil on plant growth. Building background knowledge was emphasized as the children engaged in concrete experiences with plants in a butterfly garden developed on the center's grounds. Vocabulary development was emphasized through read aloud activities based on environmental books purchased with grant funds. Concept mapping was used to document the hierarchical relationships described by the children before, during, and after learning experiences had been initiated.

This project was conceived as a foundational study in the development of young children's knowledge about plants and their role in the environment. Concept mapping has primarily been conducted with students at the upper elementary level through college levels (Novak & Gowin, 1984). There has been some seminal work in Spain and Italy (Figueiredo, Lopes, Firmino & de Sousa, 2004). In the Spanish study (Figueiredo et al., 2004), 13 children aged 3-6 years were engaged in an instructional unit about cows for a period of four weeks. Our project, lasting eight weeks, focused on the study of plants and their role in the environment.

Teachers provided instruction based on a unit of lessons they developed for the *Young Florida Naturalists* curriculum. The teachers used the *Understanding by Design* (Wiggins & McTighe, 1998) framework to construct lessons focused on big ideas and essential questions related to the science concepts incorporated in the unit plan. Instructional strategies involved the use of advance organizers or scientific beliefs about the nature of plants and the environment and the use concept mapping. Advance organizers (i.e., information presented to students prior to learning that provides general rules and examples) were identified in research as an essential strategy for use with young children. It has been documented that young children will hold on to beliefs that have been refuted by evidence/data (Zimmerman, 2005). Additionally, project teachers were trained in basic concept mapping. Read alouds continued to be a predominant instructional strategy for vocabulary and concept development; therefore, the curriculum was an extension of the school's literacy curriculum. Reinforcement of concepts occurred through hands-on experiences in the butterfly garden.

The first lesson for each class involved development of a group concept map, based on a series of 20-25 pictures. This concept map was a point of reference throughout the eight-week instructional period (March-April 2007). Modifications were made as the children learned new information (concepts) that needed to be added or as they chose to correct errors that they detected in their first attempt.

Following the first lesson, the teachers and children worked with volunteers and parents to plant a butterfly garden. Various experiments were conducted to determine the effects on the plants, e.g., effect of too much water on plants. All lessons were provided in the packet/unit developed for instruction.

2.3 Assessments

A series of three assessments was conducted to document the changes in the children's concept development and the connections made among the concepts. The assessments mirror those conducted in the study about cows that was conducted in Spain (Figueiredo et al., 2004). The assessments were as follows:

- *Assessment 1:* Task of sorting and organizing around pictures about the cow; in this project, the task involved sorting and organizing a 20-25 pictures about plants.
- *Assessment 2:* Individual talk—“What do we know about the cow?” In this project, the question was, “What do you know about plants?”
- *Assessment 3:* To assess the understanding of the concept map itself, each child was asked, “What do these images here represent? What is this scheme for?” In this project, the questions were similar and children were able to reference the class concept map about plants.

2.4 Family Involvement

At the conclusion of the instructional period, a family event was conducted. Parents were provided with a packet of materials and books, along with plants/cuttings to start a garden at home. This event was a celebration of what the children had learned. Additionally, families were invited to participate in a city-wide butterfly release and festival at a local nature preserve. Grant funds were used to pay for admissions for the families.

3 Results Related to Objectives

3.1 *Objective 1: Enable young children to correctly identify concepts and their hierarchical relationships by providing environmental experiences with plants.*

Objective 1 was addressed through the following purchases of materials and activities: a) classroom manipulative materials related to plants and butterflies; b) children’s nonfiction books about plants and butterflies; c) experiments with live plants; d) planting a butterfly garden; and e) observing the butterfly life cycle/butterfly release.

Using the advice of an Associate Professor of Biology at the local state university, we purchased classroom plant- and butterfly-related manipulative materials and nonfiction books, experimented with live plants, planted a butterfly garden, and the children observed the butterfly life cycle, and participated in a butterfly release. To prepare children for the actual experience of planting and caring for a butterfly garden, the classroom teachers conducted demonstrations showing that plants need water, air (CO₂), soil (nutrients), and sunlight. The children also planted beans (seeds) in cups so they could learn about roots, stems, and leaves. Another activity focused on the stem and its function to transport water and nutrients to the leaves and flowers. Carnations and colored water were used to illustrate the function of the stem.

3.2 *Objective 2: Enhance vocabulary development and language expansion of young children by reading aloud selected children’s books to them.*

The teachers collaborated with project researchers to select nonfiction books developmentally appropriate for the children. Each classroom received 26 books related to plants and butterflies. The books were used to implement the lessons as detailed in the unit plan. Vocabulary and concept cards were provided for the weekly lessons. The transcripts of the children’s statements during each assessment reflected the new vocabulary the children learned, such as soil, stem, nutrients, chrysalis, tap root, and fibrous root.

At the conclusion of the *Young Florida Naturalists* lessons, a family event was conducted. Families were invited to see children demonstrating activities that were included in a take-home packet, as well as view a PowerPoint© presentation of pictures taken during the project’s implementation. The demonstrations were held twice, during the morning drop-off time and during the afternoon pick-up time to accommodate parents’ work schedules. Parents were provided with a packet of materials, books, and activity suggestions, along with plants to start a garden at home. The purpose of the take-home packet was to enable parents to read to their children thereby reinforcing the vocabulary and science concepts the children learned.

3.3 *Objective 3: Help children develop concept maps based on their statements about plants and the environment.*

The three teachers constructed initial concept maps with the children in their respective classes. The teachers read two books, *The Butterfly Life Cycle* and *Green and Growing*, to stimulate the children's thinking. The concept maps were posted in the classrooms. Final concept maps were constructed with the children's input prior to *Assessment 3*.

The final class concept map was used with the children for *Assessment 3*. The *Assessment 3* Prompt was: *What do these pictures represent? This is the concept map you did with Ms. _____. What do the pictures tell you about plants?*

Project researchers videotaped each child's response to *Assessment 3*, transcribed the responses, and developed individual concept maps for each child's portfolio. Each portfolio provides documentation of the responses to assessments and shows each child's growth over the *Young Florida Naturalists* curriculum implementation period.

3.4 *Objective 4: Help scaffold children's thinking about plants and their relationship to the environment by providing advance organizers as an instructional tool.*

The nonfiction books purchased for the classrooms served to provide factual information about plants and butterflies for the lessons. Reading the books to the children served as a form of advance organizer for lesson content. The books included titles such as, *We Need Sunlight, Water, and Soil, From Seed to Plant*, and *How a Plant Grows*. Also, the teachers used the *Understanding by Design* (Wiggins & McTighe, 1998) process to develop the unit. Through this "backward design" process, the big ideas and essential questions were identified before the learning activities were planned. The big ideas and essential questions also served as advance organizers for lesson discussions and activities. Some of the big ideas and essential questions were the following:

- The world is made up of living and non-living things.
- Certain plants attract butterflies.
- What do living things need from the environment to survive?
- What are the basic characteristics of living things?

3.5 *Objective 5: Help young children develop conceptual thinking by providing opportunities to develop concept maps using word/picture cards.*

Each class constructed an initial concept map to illustrate the children's understandings about butterflies and plants. Pictures and word cards were provided by project researchers. As part of their literacy instruction, the children had been engaged in activities related to Eric Carle's book, *The Very Hungry Caterpillar*. The concept maps reflected their understandings of the life cycle of the butterfly. One vocabulary word had to be addressed through explicit instruction. Children had learned the word *cocoon* instead of *chrysalis* for the pupa stage of the butterfly. Most students had limited knowledge of plant parts and their functions.

The final concept map was constructed using pictures and word cards of plants and parts of plants provided by project researchers. Teachers led the discussions in each class. The final concept maps reflected that children could make propositions connecting second- and third-level concepts, e.g., a plant (first level) can have a flower (second level) that can provide fruit (third level).

4 Assessment Results

4.1 *Assessment 1: Task of sorting and organizing around pictures about plants and butterflies.*

The following picture, Figure 1, illustrates the organization of the pictures by Student # 1. The student used 10 of the pictures and stated the following: *Trees and roots need sunlight. (Leaf) goes on a tree and needs sun. Plant the seeds with the flower. Stem goes with flower. Caterpillar turns into chrysalis. Chrysalis turns into butterfly. Butterfly goes with eggs.*



Figure 1. Assessment 1 child's map

Children were assessed individually by project staff. Pictures of the children's concept maps were reviewed. Two-thirds (67%) of the 4-year-old children were able to make at least one, second level concept proposition about plants. Their propositions were basic, such as, "plants (first level) need sunlight (second level)." Only 35% of the 3-year-old children were able to make at least one, second level concept proposition. The 3-year-olds tended to name the pictures without making propositions. These results appear in Figure 2.

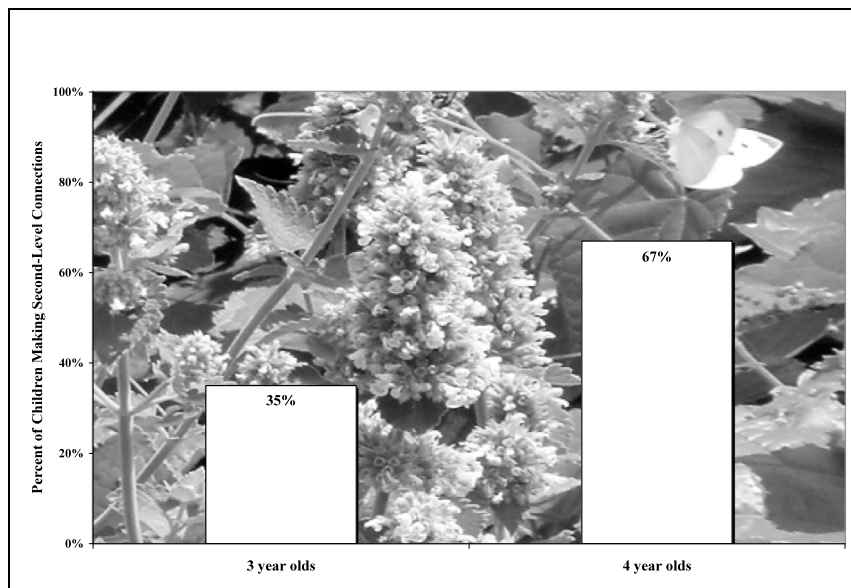


Figure 2. Assessment 1 results

4.2 Assessment 2: Individual talk—"What do we know about plants?"

As shown in Figure 3, Student # 1 was able to recall from memory three parts of a plant—stem, petals, and leaves. The student was also able to recall the process of planting seeds to grow flowers

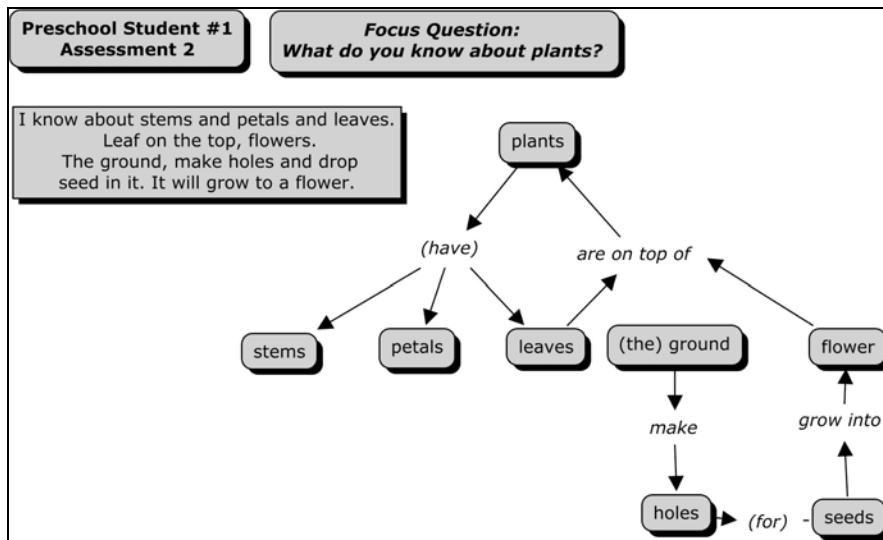


Figure 3. Assessment 2 child's map

Children were assessed individually by project researchers and their responses were transcribed. Responses ranged from 3 words to 136 words. Concept maps were constructed to reflect their statements about plants. A review of the concept maps revealed that 18 (64%) four-year-old children and 7 (41%) three-year-old children were able to make second and third level concept propositions. Results appear in Figure 2.

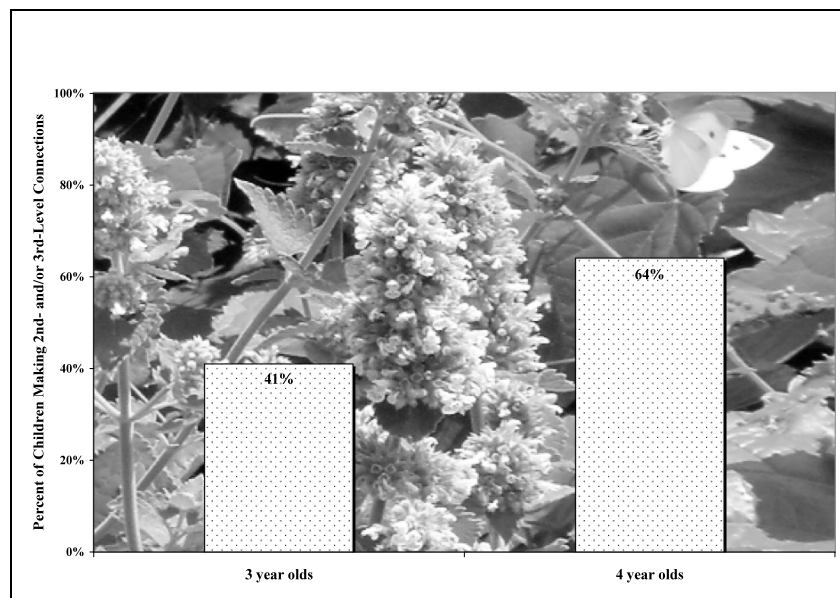


Figure 4. Assessment 2 results

4.3 *Assessment 3: To assess the understanding of the final concept map itself, each child was asked, "What do these pictures represent? This is the concept map you did with Ms. _____. What do the pictures tell you about plants?"*

The transcript of Student # 1 and the accompanying map, shown in Figure 5, illustrates the increased complexity of the three year old's conceptual development.

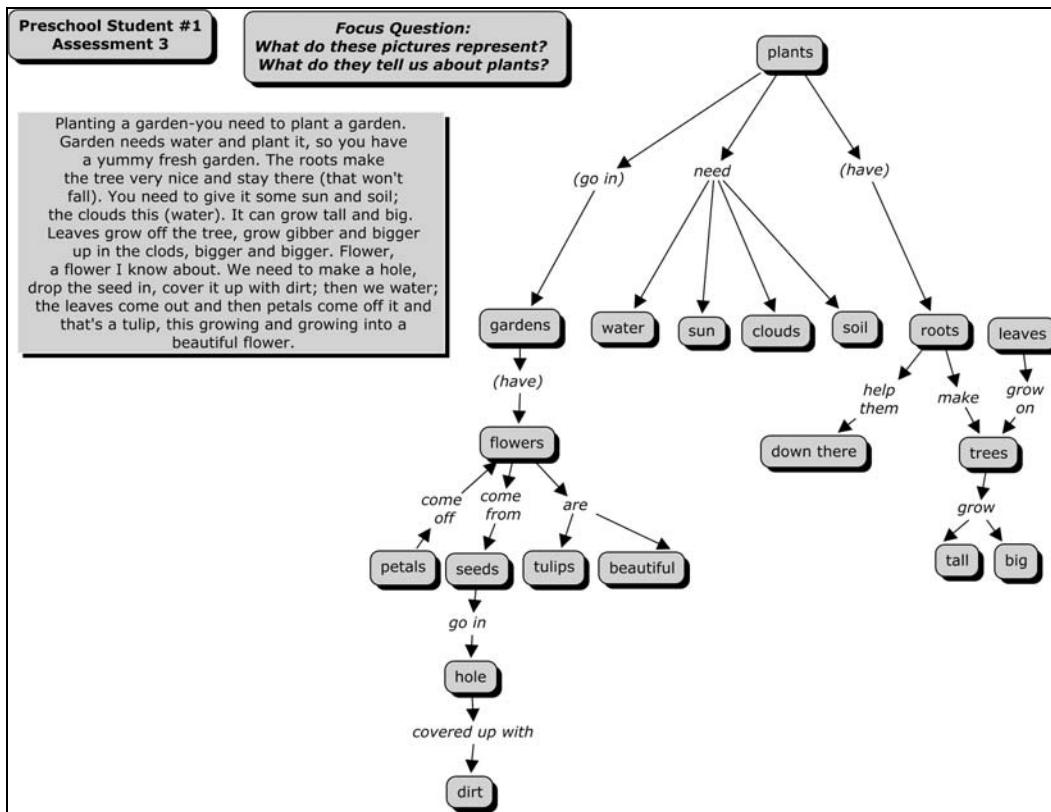


Figure 5. Assessment 3 child's map

Children were assessed individually and videotaped by project researchers. Their responses, ranging from 7 to 117 words, were transcribed, and concept maps constructed based on their statements. A review of the concept maps revealed that 28 (93%) 4-year-old children and 11 (85%) 3-year-old children were able to make second and third level concept propositions. See Figure 6. Based on the results of the three assessments, both hypotheses were rejected.

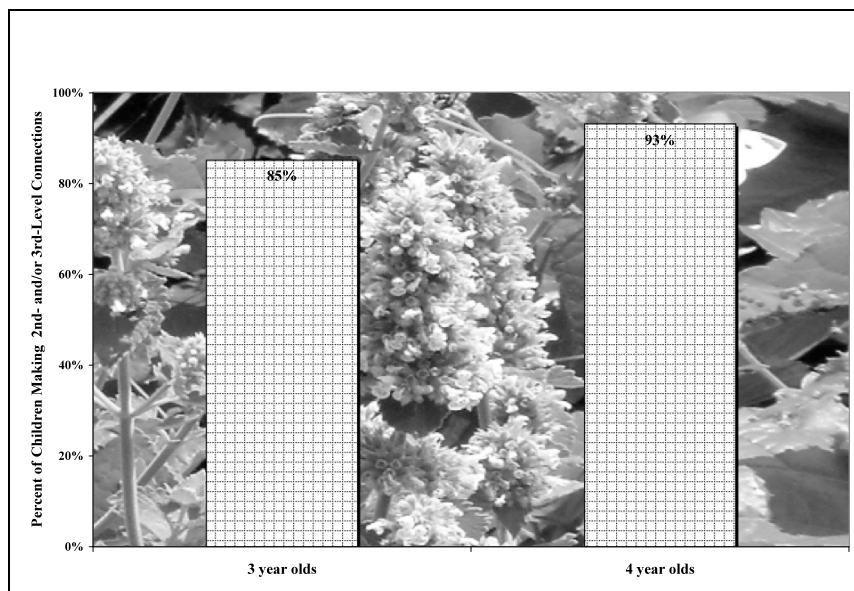


Figure 6. Assessment 3 results

5 Discussion

This project was designed to be ongoing. The teachers and children have continued to take care of the garden. (See Figures 7 & 8 below.) Plants that suffered some cold damage are sprouting again and others, like the passion flower vine, are blooming. Butterflies are being attracted to the garden once again. The garden has provided essential, hands-on learning experiences for the children.

Additionally, the teachers have expressed their excitement about how much the children have learned and have retained. The enhancement of both vocabulary and conceptual development has been validated through the children's oral responses to the assessment questions.

The learning protocols from the *Young Florida Naturalists* curriculum will be made available to other child care centers through a partnership with the local early learning coalition and to the public school district prekindergarten office. Also, a policy brief and the instructional plan will be posted on the project sponsor's Web site in an effort to disseminate the learning protocols.



Figure 7. Preschool children in garden



Figure 8. Butterfly host and nectar plants

5 Acknowledgment

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