Concept Maps: Theory, Methodology, Technology
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# IMPROVING THE ODDS: USING CONCEPT MAPPING STRATEGIES AND INFORMATIONAL BOOKS TO BUILD CHILDREN'S AND EDUCATORS' BACKGROUND KNOWLEDGE

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**Abstract** The purpose of this paper is to describe a research center's initiatives that move the use of concept mapping from learning theory to action. We use concept mapping in the context of designing professional development and instructional materials that support the use of informational texts to increase students' concept knowledge. Our work additionally includes the use of concept mapping for assessment. These applications include use in community, professional development, classroom, and after-school program settings.

## 1 Introduction

In *The Knowledge Deficit*, E. D. Hirsch (2006) documented the achievement gap in reading proficiency between Hispanic and Black children and between both minority groups and white children. Many economically disadvantaged children enroll in kindergarten as 5-year olds with a knowledge gap (Neuman & Celano, 2006). Neuman (2006) and others (Stanovich, 1980; Hamre & Pianta, 2005) point out that this gap grows in a *Matthew effect* as children with reading proficiency gain from reading while children with inadequate proficiency fall farther and farther behind.

Neuman (2006) emphasized the connection between children's background knowledge and their reading comprehension, but noted discussion about children's content knowledge and reading achievement has been minimal. Focus on skill development in isolation from content has been countered by Siegler (2001) who emphasized learning as the central connection between instruction and cognition, i.e., the more one knows about a topic, the better one understands, learns, and remembers information.

Pavio (1990) and Novak & Cañas (2008) emphasized the need to use visual representations (e.g., dual coding and concept maps) to help children understand and make connections about information they are learning. Visible thinking by definition means "any kind of observable representation that documents and supports the development of an individual's or group's ongoing thoughts, questions, reasons, and reflections" (Tishman & Palmer, 2005, p. 2). Recent research conducted by neuroscientists at Georgetown University Medical Center (2012) revealed that skilled readers rely on their *visual dictionary* rather than sounds (decoding) for word retrieval. For young children these visual connections are essential in moving them from being decoders to proficient readers.

Teachers' use of instructional strategies that scaffold children's acquisition of knowledge is a key to closing the knowledge gap. Teachers need ongoing support including targeted professional development opportunities and in-class coaching to improve the quality of instruction taking place in their classrooms (U. S. Department of Education, 2010). If teachers' expertise in scaffolding children's vocabulary and concept development is to increase, professional learning experiences should target instructional strategies designed to enhance children's concept development. Concept mapping is a strategy that teachers can use to plan lessons in ways that help students' make connections between their existing and new knowledge.

## 2 Theory to Action

Guided by the theoretical framework, staff at a university-based research center developed professional development experiences and instructional materials depicted in Figure 1. Emphasis included creating and using informational texts to build children's concept development and background knowledge. Partners include a large, urban school district with 177 schools serving 125,000 students; community advocates seeking to improve outcomes for children especially those who live in poverty; and community-based early childcare providers.

The professional development experiences and instructional materials incorporated the use of concept mapping because concept map creation forces the mapper to make explicit the relationships among concepts, thus, making thinking visible. Concept mapping is used to scaffold children's learning encourages concept development in ways that call upon children to use language to express what they know and relate new

information to existing knowledge. For children, concept maps provide a visual image that help makes explicit what they know, connect existing and new knowledge, and spark future inquiry.

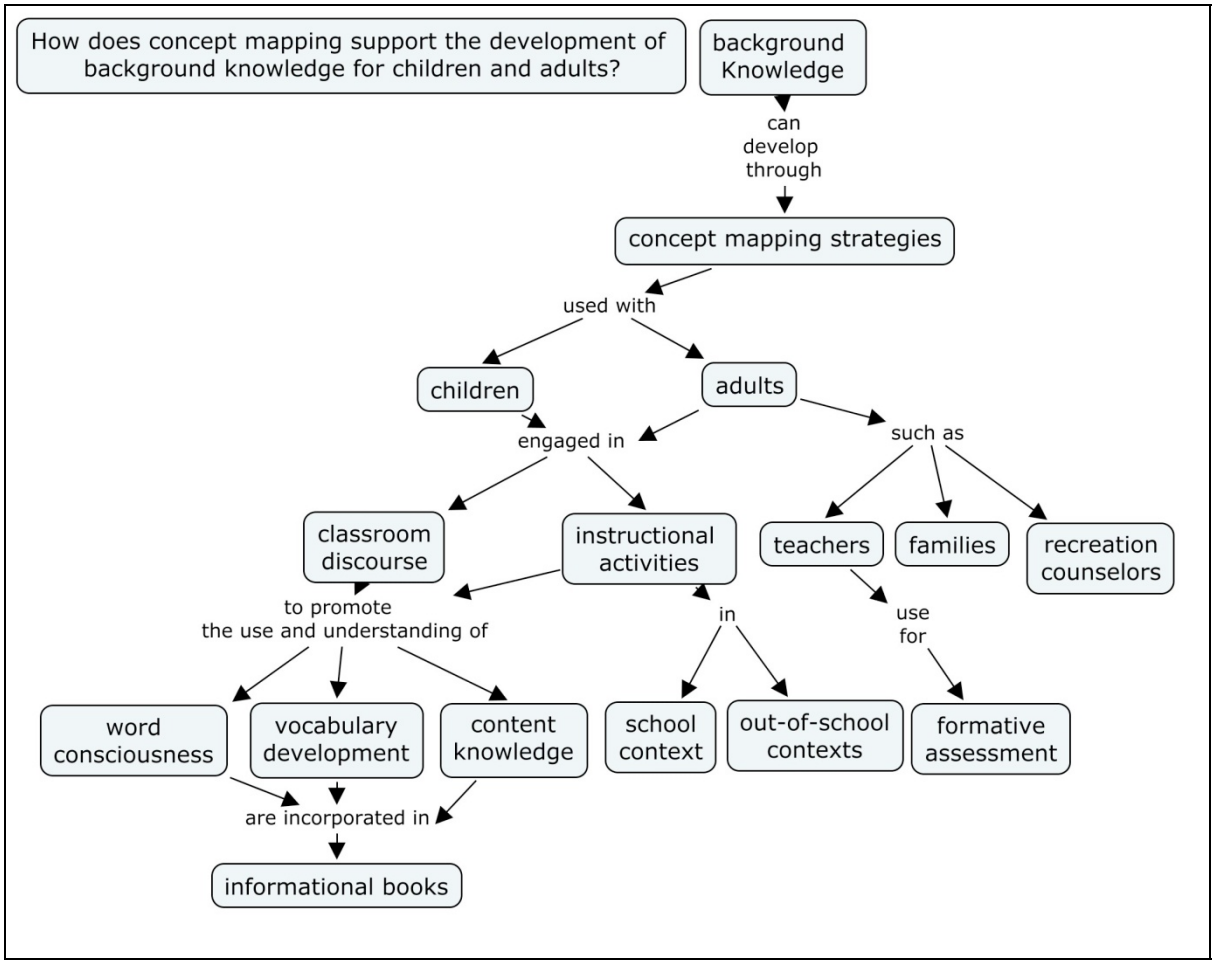


**Figure 1:** FIE concept mapping applications from theory to action.

### *2.1 Purpose*

The purpose of this paper is to describe the evolution of our use of concept mapping in the context of designing professional development and instructional materials that support the use of informational texts to increase concept knowledge. Our work also includes the use of concept maps as advance organizers and for assessment. These applications have been used in classroom settings, after-school programs, in summer learning settings, and in professional development settings.

## 3 Concept Mapping Used in Multiple Learning Contexts

Our vision for expanding the use of concept mapping includes published center-authored informational texts for young children and adults working in both traditional classrooms and out-of-school learning environments. This strategy is based upon theories of knowledge acquisition and concept mapping. Current applications of this process are detailed in the project descriptions below and represented in Figure 2.

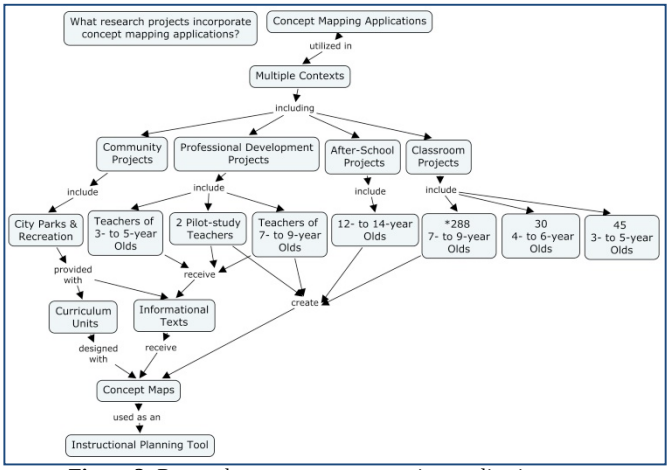


**Figure 2:** Research center concept mapping applications.

### *3.1 Community Projects*

Working in collaboration with the city's parks and recreation department, center researchers developed curriculum units and informational texts for use by 5- to 10-year olds in summer camp programs in 2010, 2011, and 2012. Summer camp counselors received lesson plans and instructional materials aligned with science content. (See concept map in Figure 3.) Researchers incorporated concept maps in curriculum units using two methods: They created maps to connect science concepts in meaningful ways for camp counselors to use to plan lessons and to use in lesson activities to support children's understandings of the science concepts presented in books, discussions, and camp activities. More than 1,500 children participated in summer camp programs each year. The partnership between the research center and the city parks and recreation department supports a city-wide goal of improving literacy outcomes for all citizens.

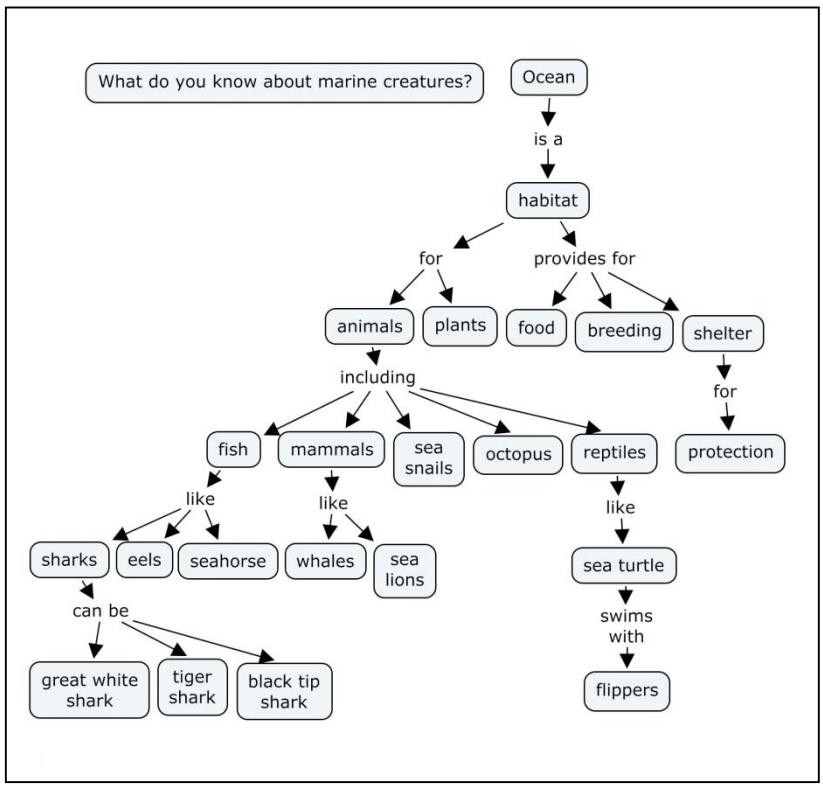


**Figure 3:** Concept map used to develop background knowledge for science literacy lessons.

### *3.2 Concept Mapping with Teachers—Professional Development Projects*

Whenever possible, research center staff incorporate concept mapping strategies in a variety of settings. This was accomplished by creating concept maps for informational books used in professional development initiatives that impact teachers and children. Figure 4 depicts a book cover and embedded concept map of a research center-authored informational book.

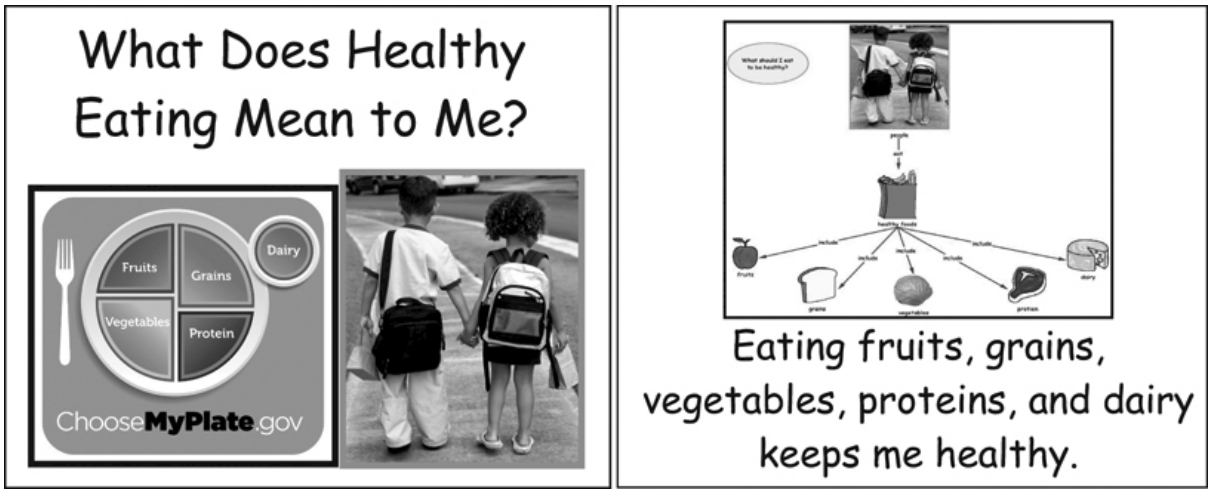


**Figure 4:** An example of a book cover and embedded concept map from a center-authored informational book.

In 2010-2012, center researchers designed and implemented three professional development projects using concept mapping. One project focused on teacher professional development, called HUBS, using informational

books and concept mapping activities presented using a technology-focused delivery system. The second project focused on a professional development series for teachers of 7- to 9-year olds designed to improve children's concept development by focusing on background knowledge related to science informational books. The third professional development project involved two teachers of 4- to 6-year olds and their use of concept mapping to plan and deliver instruction. Concept mapping was a primary strategy used in the delivery of the professional development sessions for all three projects.

The HUBS project was developed to improve children's phonological awareness, emergent writing, and language skills. The design of the series, based in part on findings that teachers were more likely to use concept mapping strategies in their instruction when concept mapping was presented in a variety of ways during training sessions, incorporated different approaches to the presentation and implementation of concept maps (McLemore, England, & Hunter, 2010). To that end, center staff authored and published informational books (Figure 4) based on the curriculum in use by the teachers. Each book incorporated the background knowledge from the curriculum and rich language designed to support the development of children's phonological awareness, emergent writing, and language skills. Examples of rich language include alliteration, rhyming words, and word repetition. The books also include a concept map that summarizes the background knowledge. One teacher said of the books, "I like the books that you have given us to use in the classroom. We have used them for writing lessons and for the class library. The books are simple to read and many of our students like to "read" the books. I would like to receive more of the books that support our themes."

The professional development series developed for teachers of 7- to 9-year olds involved teachers creating, using, and analyzing concept maps with Kidspiration© software. One goal of the professional development was to demonstrate for teachers how to use concept mapping to plan meaningful instruction by identifying key concepts in informational books and textbooks. This kind of planning helps teachers make explicit, in instruction, the connections between the identified concepts. Figure 5 shows a concept map produced by one teacher to plan instruction for functional writing.

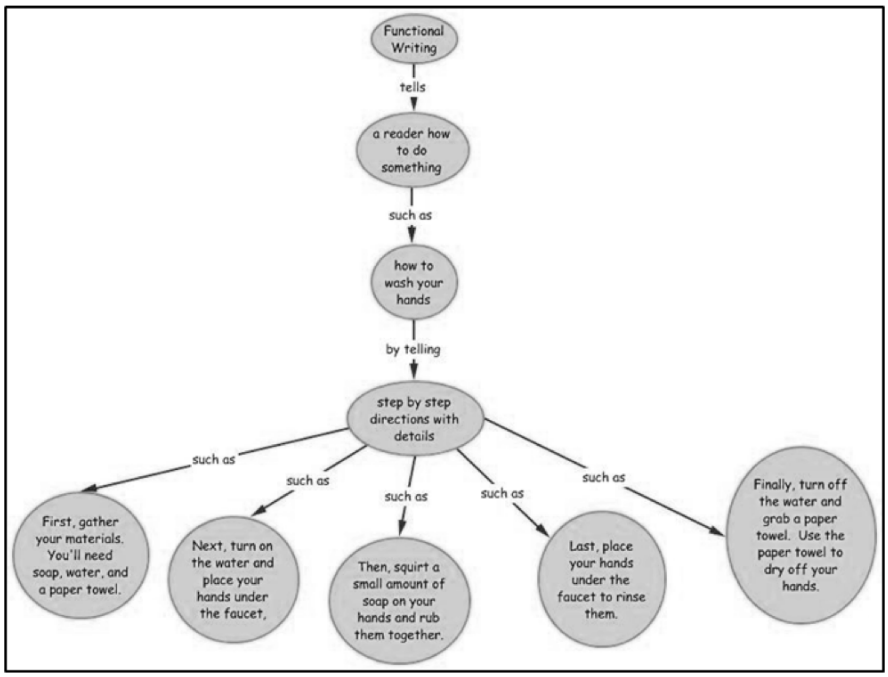


**Figure 5:** Concept map created by a teacher to plan instruction.

Finally, a pilot study involving two early childhood educators was implemented in the 2010-2011 and 2011-2012 school years. Each teacher received on-site coaching support from a center researcher, informational books with concept maps, and lesson plans. The use of concept maps helped make children's thinking visible. Visual representations reflect the children's progressive understanding of the presented knowledge. The researcher modeled strategies for using concept maps with young children to generate ideas, and connect previous knowledge with new knowledge. The researcher and teachers met regularly to discuss successes, identify barriers, and ideas for further concept mapping uses in their classroom instruction. The planning map developed jointly by the teachers is shown in Figure 6.

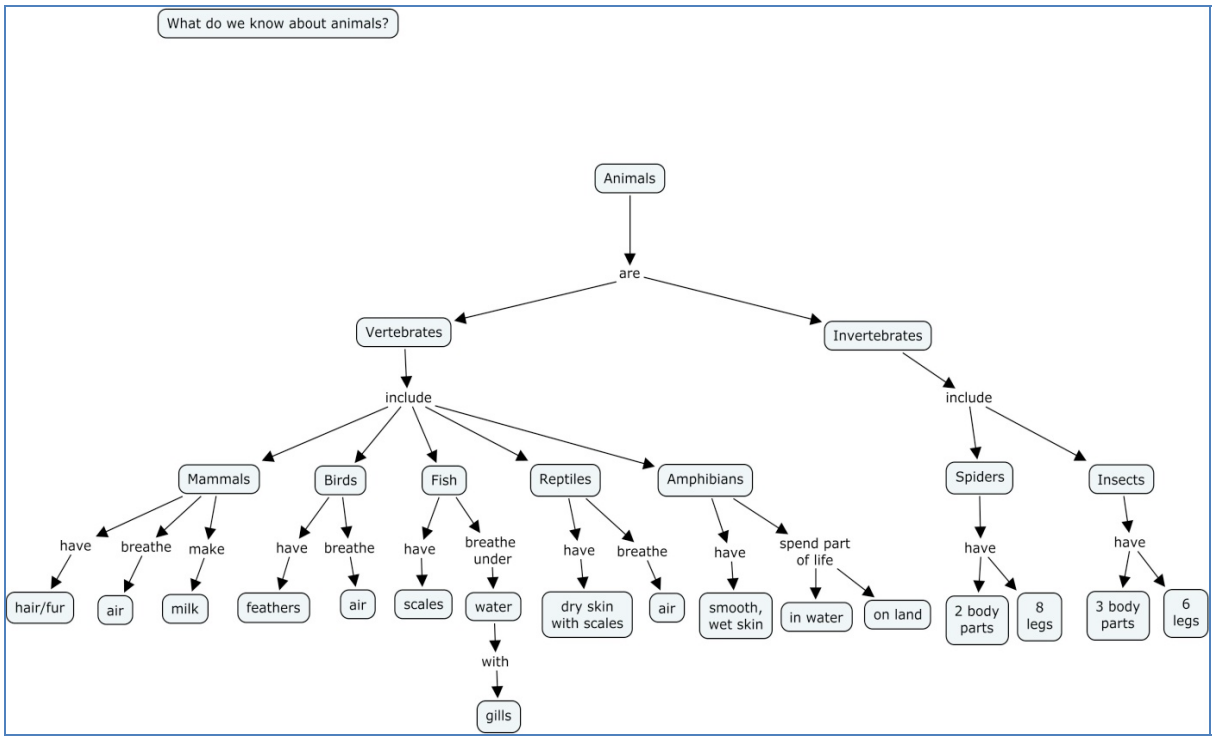


**Figure 6:** Concept map used as a planning tool.

### *3.3 Concept Mapping with Children –Classroom Projects 2011-2012*

Because 3- to 5-year olds are developing as readers and writers, researchers working with children in the HUBS project collected language samples and created concept maps using transcribed interviews. This approach was based upon the work of Figueiredo, Lopes, Firmino, & deSousa (2004) and has been used to help children make connections among the concepts being taught and to assess their understandings. Figure 7 shows a concept map created from a 5-year-old child's transcribed language sample. Audio recorded language samples and written work samples were collected from approximately 60 children in 12 classrooms.

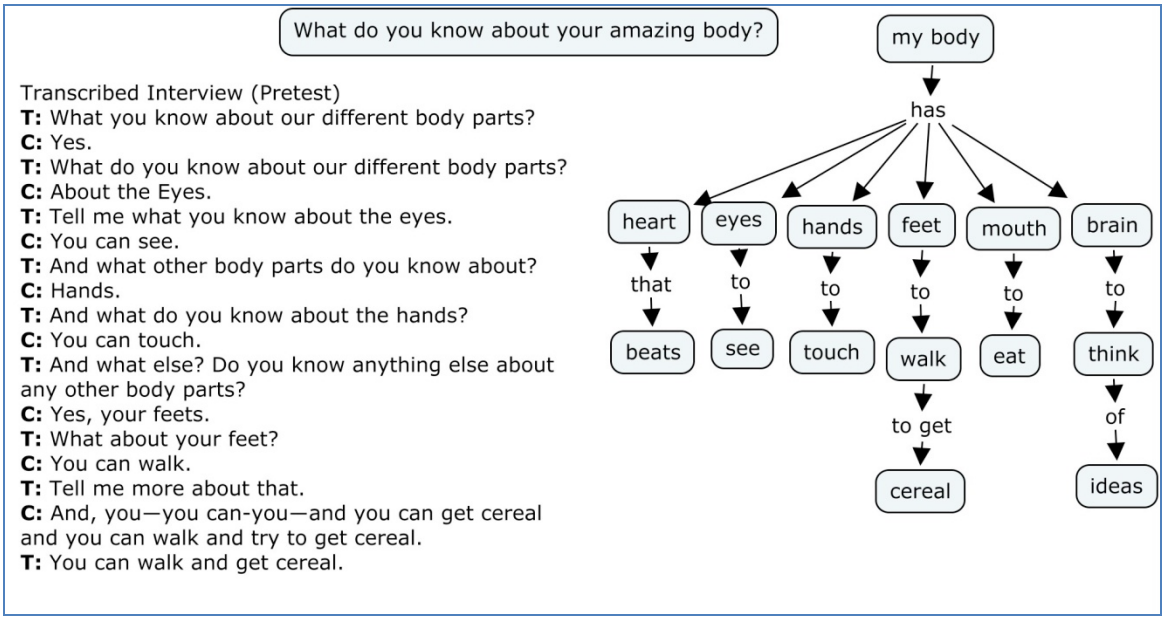


**Figure 7.** Transcribed language sample and derived concept map. Both receive scores in the embedded empirical study.

Using Kidspiration© software, 7- to 9-year-old children created concept maps. As teachers became more experienced concept mappers, the opportunities for children to create individual concept maps increased. End-of-unit projects related to science concepts such as habitats, mammals, and motion were topics for child-generated maps. (See Figure 8 for an example of a child-generated concept map.) Approximately 288 children in 16 classrooms participated in the project.

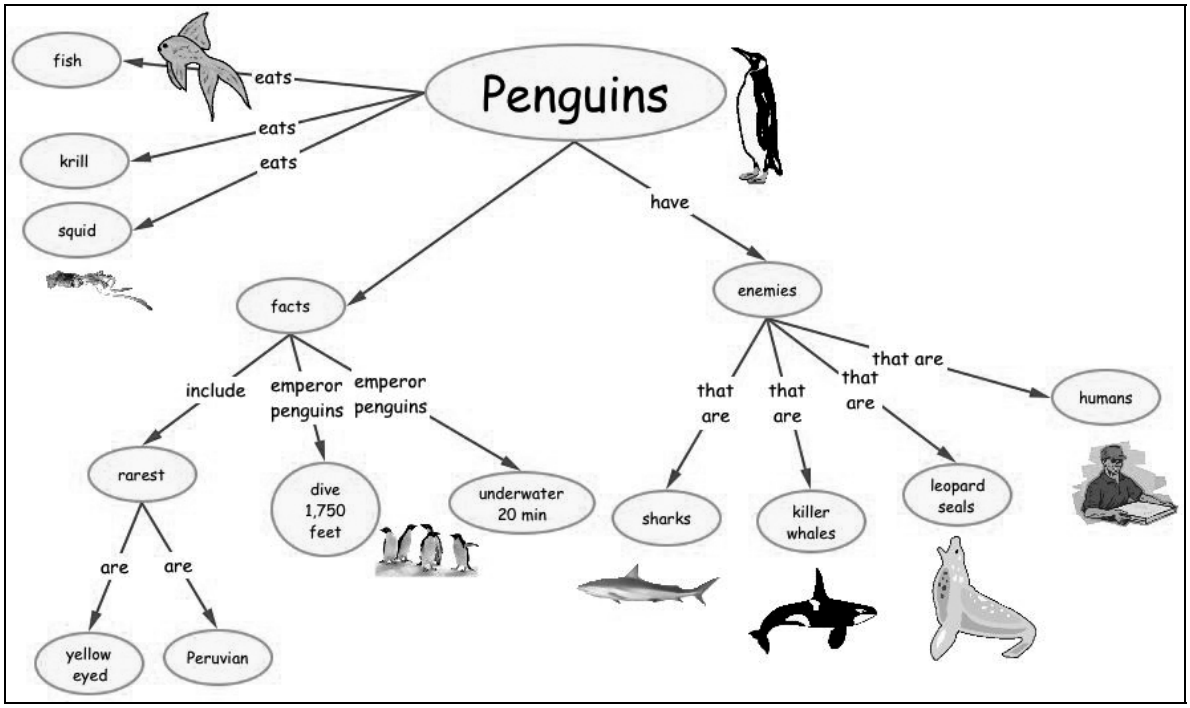


**Figure 8:** Child-generated concept map of his knowledge of penguins.

### *3.4 After-school Projects*

Beginning in 2007 and continuing to present, middle school students' who participated in the research center's after-school program have created concept maps to represent their understanding of content related to human geography (Monroe-Ossi, Wehry, & Fountain, 2010; Wehry, Monroe-Ossi, Cobb, & Fountain, 2012; Wehry, Monroe-Ossi, & Fountain, 2010). Figure 9 shows a child-created concept map related to self-concept. The map was created after 18 weeks of program sessions. Approximately 120 students participate in this after school program each year.

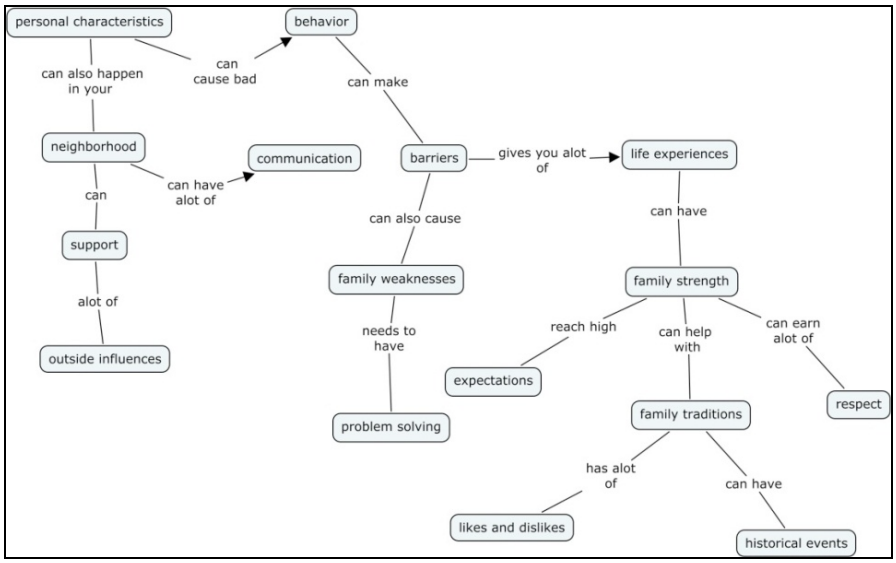


**Figure 9:** Student-generated concept map depicting her knowledge structure of *self-concept*.

## 4 Significance

We enumerated concept mapping projects spanning multiple years and contexts, involving state and community agencies and advocates, and multiple age groups. Our projects, sponsored by the state, the school district, the city, and the university show promise. Satisfaction with the projects is demonstrated at the policy level by on-going sponsorship. The state and university have supported the after-school project since 2007 and support will continue at least through the 2012-13 academic year. The center is just completing the first year of a school district 3-year commitment requesting that center staff create and deliver professional development for teachers of children with special needs, from low-income families, or both. The city's parks and recreation project began as a single summer project; however, parks and recreation staff has requested center staff to continue this project every summer. Teachers in the HUBS project use web 2.0 applications to provide feedback to center researchers. The teachers are requesting more center-authored informational books with embedded concept maps. In fact, one teacher suggested the center provide a complete set for each child in her class. While she may think she is reaching for the stars, center staff will work hard to expand the collection of books and provide more copies for class libraries. The penguins map shown in Figure 8 reinforces our commitment to help students engage in meaningful learning.

These projects demonstrate that, at all levels, concept mapping strategies are embraced by teachers if presented in the context of well-planned professional development along with in-class coaching and support. Concept mapping is working in these projects and teachers are implementing concept mapping strategies. Pairing concept mapping with professional development helps teachers make explicit their own thinking while also developing strategies they can use to scaffold children's concept development.

We have growing documentation that supports teachers' satisfaction and increases in children's concept knowledge. As our understandings deepen, our concept mapping applications expand. In every project, we have gained insight into what we are doing that is working, where and how to revise projects to incorporate teachers' suggestions, and how and where to scale-up our work.

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