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Abstract
Concept mapping is an inquiry technique that provides students at all ages with opportunities to demonstrate learning through performance. A concept map refers to a graphic/visual representation of concepts with linking connections that show various relationships between concepts (Novak & Gowin, 1984). Assessment is an ongoing process integrated with instruction across subject areas. The National Council of Teachers of Mathematics (NCTM) emphasizes that assessment should focus on both the enhancement of student learning as well as serve as a valuable tool for making instructional decisions (NCTM, 2000). Assessment activities can take on a variety of forms, one being performance tasks. In this manuscript, an explanation of concept mapping is provided for learners ages 3 – 12 along with several examples of concept maps for young learners, including examples from an assessment project in the subject area of mathematics. Also presented are the numerous benefits of the concept mapping technique for both students and teachers.

Resumen
Los mapas conceptuales son una técnica de investigación que provee a los estudiantes de todas las edades la oportunidad de demostrar el aprendizaje a través de su representación. Un mapa conceptual nos lleva a una representación gráfico-visual de los conceptos, con enlaces que muestran relaciones entre distintos conceptos (Novak y Gowin, 1984). La evaluación es un proceso continuo e integrado en la enseñanza de cada materia. El National Council of Teachers of Mathematics (NCTM) pone énfasis en que la evaluación debería centrarse tanto en la mejora del aprendizaje como en servir como una herramienta valiosa para la toma de decisiones en la enseñanza (NCTM, 2000). Las actividades de evaluación pueden tomar formas muy variadas, siendo una de ellas la realización de tareas. En este artículo se ofrece una explicación de los mapas conceptuales para estudiantes de edades comprendidas entre los 3 y los 13 años, junto con varios ejemplos de mapas conceptuales para niños y jóvenes, incluyendo algunos de un proyecto de evaluación en el área de matemáticas. También se describen los numerosos beneficios del uso de mapas conceptuales tanto para estudiantes como para profesores.

Keywords
Concept maps, inquiry, early childhood, primary, elementary, learners, mathematics.

Palabras clave
Mapas conceptuales, investigación, primera infancia, educación primaria, aprendices, matemáticas.

1. Introduction

As children experience the world around them, they interpret their environment and form ideas about phenomena. While many of children's interpretations of phenomena are correct, many are incorrect. As children mature, their interpretations of phenomena change, yet while young, children have many preconceptions and misconceptions about their world. Young children often attempt to assimilate new experiences to their existing schemes, which can result in misconceptions rather than accommodate knowledge from their newly acquired experiences. An important task for teachers is to design experiences that provide opportunities for students to correct their preconceptions and misconceptions. The task of the teacher is to facilitate the learner's continuing accurate construction of old and new schemata (Kellough et al. 1996). Yet, once a concept is thought to be correct, it is often challenging for educators to change a young child's mind concerning what he/she perceives a situation to be. Considering that children's beliefs influence their receptiveness to new information, educators are always eager to try instructional strategies that will assist learners in changing their misconceptions and accepting accurate explanations of phenomena (Howe & Jones, 1993). Concept mapping has been shown to be an excellent tool for facilitating learners' assimilation and accommodation of knowledge and helping students change their misconceptions (Kellough et al, 1996).

In this manuscript, an explanation of concept mapping along with the benefits for learners and teachers is provided along with several examples of concept maps representing various age levels and subject areas.

2. Concept Mapping

Concept mapping was developed by Joseph Novak (1984), a science education researcher, who was interested in strategies that assist students learn how to learn. Novak's concept mapping technique was based on David Ausubel's theory of meaningful learning, whereby a learner links new concepts to previously experienced concepts. Novak's concept mapping technique has been successful in helping students change their misconceptions about their world by clarifying connections between concepts (Kellough et al, 1996). Concept mapping is often used by science educators on the elementary and secondary level but it is also effectively used with other subject areas and with younger learners. Concept mapping facilitates conceptual building as well as accurate understandings of prior and new knowledge.

A concept map refers to a graphic/visual representation of concepts with linking connections that show various relationships between concepts. A concept map serves as an organizational tool of knowledge from the most general to the most specific. Usually, concept maps are represented in a hierarchical format, with the more general concepts at the top and specific supporting concepts toward the bottom. When constructing a concept map, learners should be instructed to place the most general term/idea at the top of their concept map and connect the remaining concepts below the main idea. For example, the concept of a plant is related to the concepts of leaves, stems, roots, flowers, air, water, sunshine, etc. (Daugs, 1993). When constructing a concept map using words, learners can be instructed to write the word "Plant" at the top of their concept maps and connect the other suggested concepts below the word plant. They can then draw lines connecting the concept terms while writing linking words (usually verbs) on the lines to show their perceived connections (See Figure 1). An arrow placed at the end of each connecting line signifies the flow of each idea, usually stated in short sentence form. In referring to the diagram, you will notice that the last word of one thought is also used as the first word for the following connected thought. For example, "Plants have leaves" would then be followed by and connected to "Leaves can be green". Another example, this time using pictures and objects, is of an Analog Clock (Gallenstein & Larmon, 2012). In referring to the Analog Clock concept map (See Figure 2), you will also notice that the last word of one thought is also used as the first word for the following connected thought. For example, "An analog clock has a short hand" would then be followed by and connected to "A short hand shows the hour".

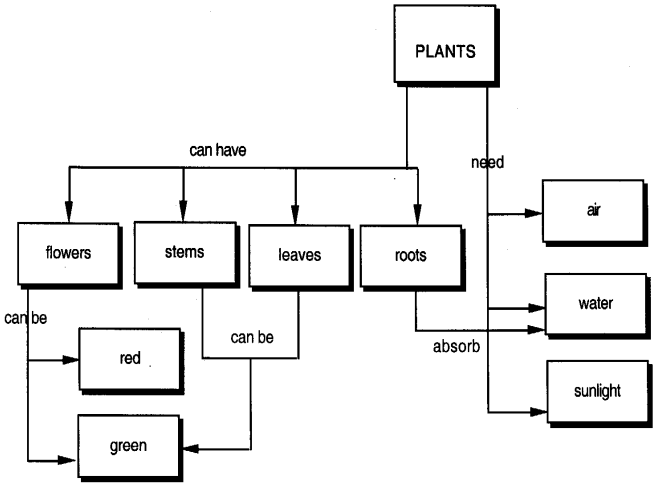

Figure 1. Plants

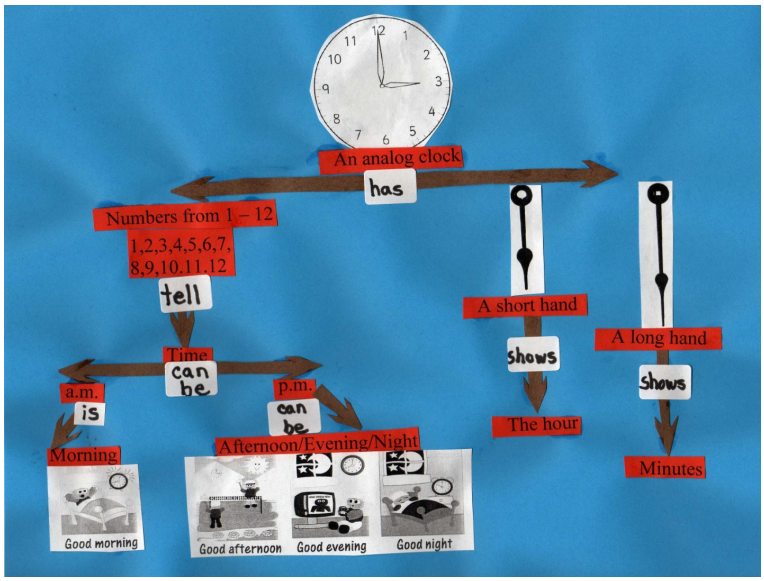

Figure 2. Analog Clock – Primary Grades, Ages 5 – 8

Allowing children to work cooperatively while exploring their world provides them with opportunities to discuss their experiences. Often a child's peer will have a different perception of a particular experience. When this occurs, children can listen to each other, discuss their conceptions, and work toward an accurate understanding of the phenomenon. Educators should design and facilitate experiences in order that children can acquire correct conceptions of their world.

Educators can design hands-on, minds-on learning opportunities in order for students to experience for themselves accurate conceptions of phenomena that were determined to be previously misconceived through the use of concept maps. Through the process of assimilation and accommodation, students who originally held inaccurate beliefs about phenomena can often clarify their thinking and experience equilibration. But, educators need to understand that changing children's misconceptions is not an easy task. It often takes time and patience. Educators must listen carefully to their students and provide many opportunities for questions and discussion that accompany hands-on, minds-on learning.

3. Concept Mapping for All Ages

Concept mapping, as currently represented in most textbooks, is an appropriate technique for upper level students who have reading and writing skills. We often don't think of concept maps as

something that is appropriate for younger learners. Yet, concept mapping can be adapted for young learners, providing them with many of the benefits it does their older counterparts.

Young learners can participate in creating concept maps on their appropriate learning and developmental levels and in a variety of subject areas through the use of objects (concrete level) and/or pictures (pictorial/representational level). For example, children are provided with opportunities to see logical connections with new material and previously acquired knowledge. Also, concept mapping promotes critical-thinking skills through the use of observation, comparison, classification as well as problem solving and decision making. In addition, teachers can use concept maps to introduce or conclude a topic or as an activity within a lesson/unit. They also provide teachers with valuable information in assessing students' learning progress (Gallenstein, 2005).

Charlesworth and Lind (2010) recommend that materials used for conceptual activities meet children's level of development. "For each concept included in the curriculum, materials should be sequenced from concrete to abstract and from three-dimensional (real objects), to two-dimensional (cutouts), to pictorial/representational, to paper and pencil" (p. 43). Children must be provided with opportunities to manipulate and move materials in order to understand the concepts emphasized before introducing paper and pencil activities.

Concept maps for young learners uses manipulative objects or pictures appropriate for children's level of development. Rather than using only words (symbolic/ abstract level), young children can create concept maps by arranging objects (concrete level) and/or pictures (pictorial/representational level) in a format with general concepts at the top and supporting concepts positioned below them. Connections can be made between concepts through the use of laminated paper arrows, string/yarn, pipe cleaners, footprints mapping the path, etc. The teacher can write the children's suggested linking words on the laminated arrows as they share their thoughts. The arrows show the flow of ideas on the concept map and provide students with opportunities to "read" the completed concept map story for understanding. Students can also make new connections by rearranging the items, allowing for diverse perspectives to be expressed. Very young children will experience success with concept maps with three-dimensional objects or pictures. As students' literacy skills progress, however, teachers can build more complex concept maps with objects, pictures, picture word cards, and words only. In addition, software programs, such as *Kidspiration* (seeInternet Resources), provide opportunities for children to create concept maps with pictures or words.

Following, are examples of concept mapping techniques appropriate for children's various developmental levels, beginning with the concrete level (actions on objects) and leading to the pictorial/transitional level (pictures) (Gallenstein, 2003). These examples should provide you with practice building concept maps.

3.1. Concrete Concept Map

- Topic/Theme: Animals
- Grade Level(s): Preschool - Second
- Ages: 3-8
- Created by: Natalie Richards, Melanie Graham, and Janell Bachelier
- Materials: A large blanket for the floor, small/medium/large sentence strips for labels and arrows, large pictures of various living environments (e.g., water, land, sky), and a variety of different bean bag animals (e.g., bear, bird, fish, etc.)
- Procedures: (Note: This project will be presented as a learning activity to follow a unit that has been presented to students about the environment and in what places different types of animals might live.)
    - Begin by spreading out the blanket and asking students to sit on the floor around the edges.
    - Once students are seated, begin to place all of the various bean bag animals around on the blanket.
    - Ask, "Looking at all of these things here, can you tell me what they all are?" (They're bean bag animals!) Ask, "What kind of bean bag animals are they?" "What do they represent?" (different kinds of animals)
    - Display the sentence strip with the word "ANIMALS" (and a large picture with a variety of animals) on it at the very top of the blanket and share, "Remember how we have been talking about different kinds of animals and where they might live?"

Well, today I'd like you to help me organize these animals and put them together (group them) according to where they might be found."
    - Ask, "Who can tell me where one of these animals might live?" (A fish lives in water.) Place an arrow with its base at the word ANIMALS and point it toward the picture of "water". Write the word "lives in" on the arrow strip. Have the student place the fish bean bag on the water picture.
    - Continue with each of the other animal bean bags. Ask each student to share where each animal can be found (habitat). Students should place each animal bean bag in the appropriate habitat.
    - Next, have students investigate the animals in each of the habitats that they have grouped and encourage them to create other groups by looking at the similar characteristics of the animals. Assist them with arrows and linking words.
    - When all of the possible groups have been formed, ask for a volunteer to "tell the story" of the animals by following the arrows along the map. Model an example for the students first so that they have an understanding of what you would like for them to share.
- Extensions:
    - Categorize the animal groups even farther as to where they can be found such as at the zoo, home, farm, etc.
    - Focus on only one habitat at a time such as animals found on land, in water, or in the air.
    - Students can string animals together and create an ANIMAL mobile concept map.
    - Place animals and habitat words in a learning center for further investigation.

3.2. Concrete/Pictorial Concept Map

- Topic/Theme: Germs
- Grade Level(s): Kindergarten - Second
- Ages: 5-8
- Created by: Aimee Jordan and Tiffany Rohrer
- Materials: Towel, water bottle, tissues, cough drops, soap, a traced hand on a note card, band-aids, pictures of family, food, cut yarn strips, poster board, and note cards
- Procedures: (Note: This project will be used after a unit on germs has been presented.)
    - The teacher will ask students to share what they have learned during their unit on germs.
    - After the students are paired, the teacher will distribute objects and a word card with the name of each object on it to each pair of students. (E.g., water, soap, towel, hands, sneeze, cough, cut, food, band-aid, etc.).
    - Students will have time to observe their object with a partner and talk about how the object relates to germs.
    - Students will then share with the class what their object is and how it relates to germs. - The teacher will explain to the students that they will make a word map showing how the words (objects) relate to germs.
    - The teacher will guide students by listening to their suggestions and giving clues when needed. (E.g., Giving a linking word such as "spread by" and letting students figure out who has objects that spread germs.)
    - Students will physically make a concept map by lining up in groups and using yarn and linking words to connect their objects/words to the word germ.
    - When completed, students will place their objects/words and yarn on the floor and observe what they have created.
    - Students will then explain their concept map on germs and tell how and why the yarn connects the objects.
    - Encourage students to think of other ways that the objects/pictures might be connected.
    - The teacher will listen to the students' explanations in order to evaluate if students connected the objects/words correctly and record their accomplishments on a checklist.
- Extension:
    - Place concept mapping materials in a learning center for students to further explore various connections between the objects/words.
    - Following are photographs of concept maps appropriate for children's various developmental levels. The mathematics concept maps that follow were designed by elementary pre-service teachers and implemented in actual classroom settings. (See Figures 3 – 11).

Figure 3. Time with Clock – Primary Grades, Ages 5 – 8

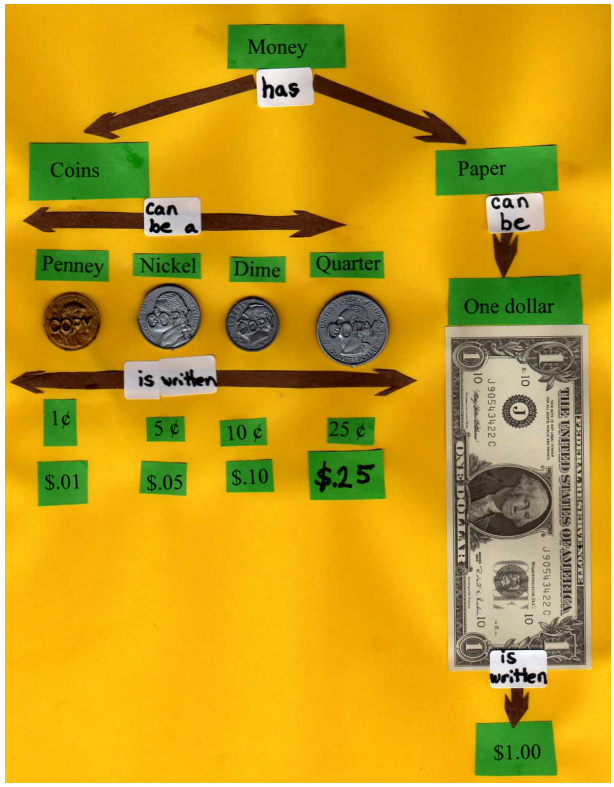

Figure 4. Money – Primary Grades, Ages 5-8

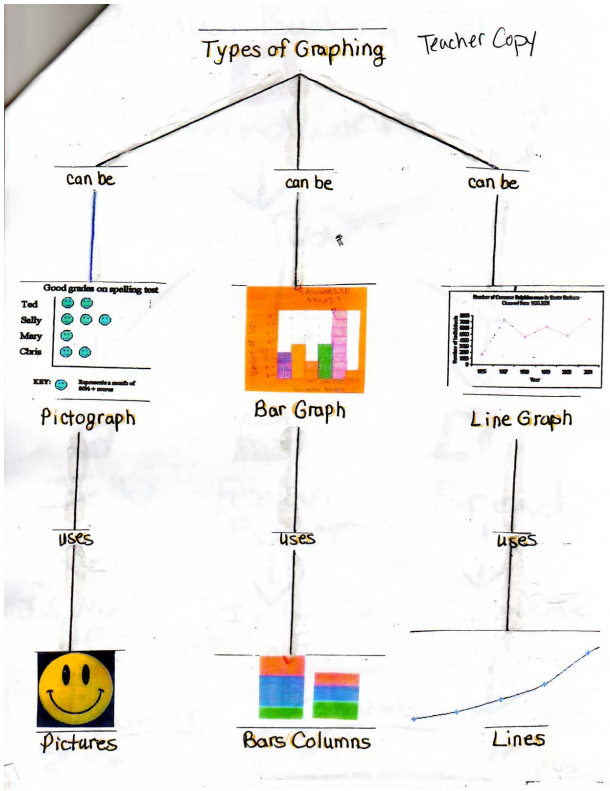

Figure 5. Types of Graphs – Primary, Ages 5 – 8

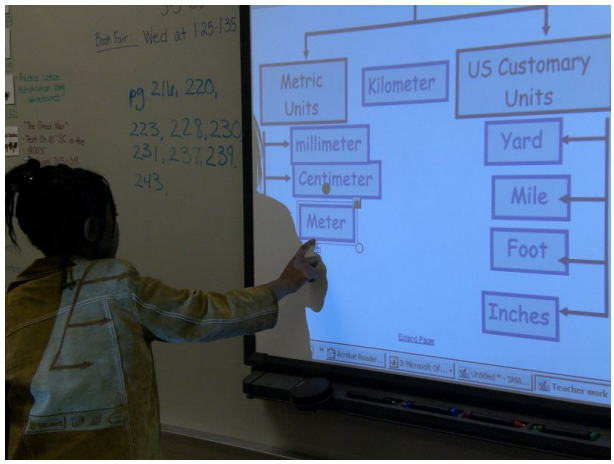

Figure 6. Units of Measure – (Smart Board Application) Grade 3, Age 8

Figure 7. Geometry – Grade 3, Age 8

Figure 8. Fractions - Grade 3, Age 8

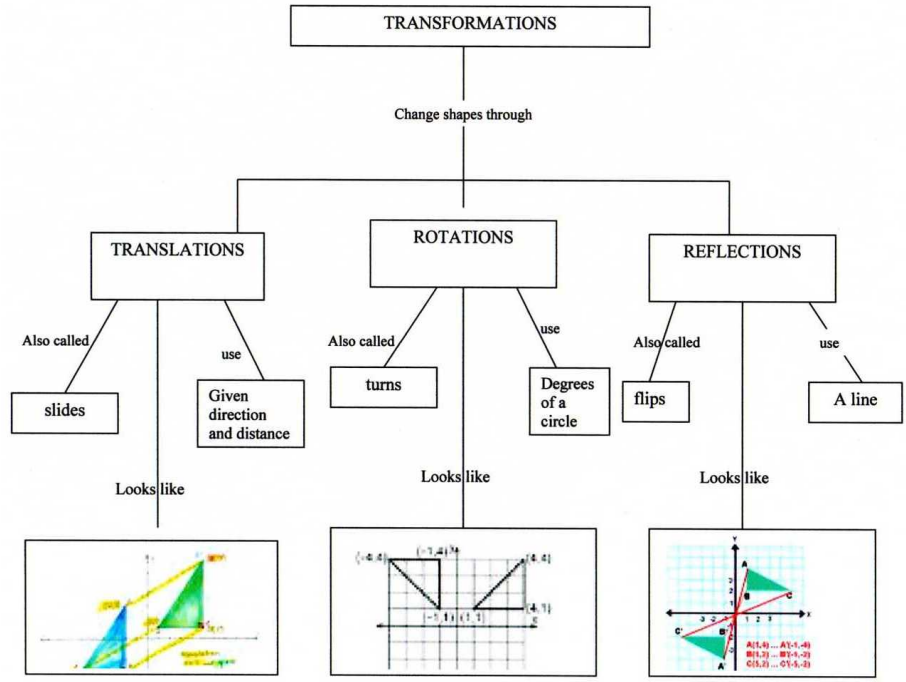

Figure 9. Transformations – Grades 3 – 5, Ages 8-10

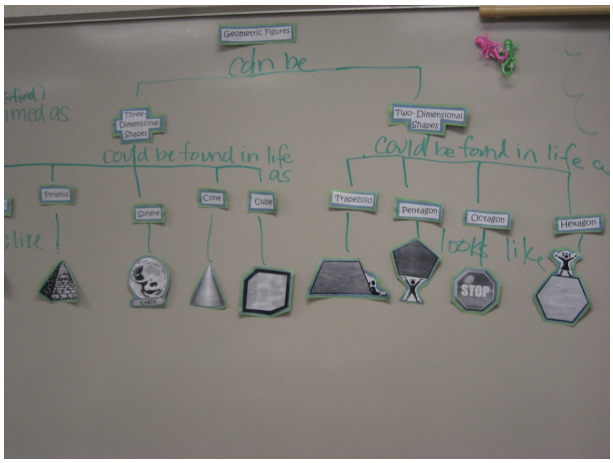

Figure 10. Geometric Figures (Laminated Words & Pictures with Magnetic Tape) Grade 5, Age 10

Figure 11. Metric Measurement - Fifth Grade, Age 10

4. Concept Mapping as an Assessment Tool

Assessment is an ongoing process integrated with instruction (NCTM, 2000). In 1995, the National Council of Teachers of Mathematics (NCTM) published *Assessment Standards for School Mathematics*. In 2000, these standards were reinforced in the NCTM's *Principles and Standards for School Mathematics.* NCTM emphasizes that assessment should focus on both the enhancement of student learning as well as serve as a valuable tool for making instructional decisions (NCTM, 2000).

Assessment activities can take on a variety of forms, one being performance tasks. "To assess learning, the teacher must prepare activities, projects, and tasks that the student performs in order to learn, and from which assessment information can be captured" (Troutman and Lichtenberg, 2003, p. 274). Students can demonstrate their knowledge acquisition by explaining, demonstrating, drawing and acting out. Concept mapping is a technique that provides students with opportunities to demonstrate learning through performance.

Through the use of concept maps, students have opportunities to organize their thoughts in a graphic/visual format, while connecting concepts, and linking prior knowledge to new knowledge. Concept maps also provide students with opportunities to think about their own thinking as they reflect on what they know or what they need to have clarified. Additionally, through students' visual representations and sharing of knowledge, teachers can assess and determine if students' concept connections are accurate. When misconceptions are evident, students with accurate conceptions can often clarify misunderstandings within their learning groups, which is in line with Vygotsky's theory of the Zone of Proximal Development, whereby a more competent student or an adult facilitates accurate conceptual understandings. Also, children's conversations while creating concept maps can lead to the development of language used to describe scientific and mathematical concepts (Kellough et al. 1996). With the development of concepts and their relationships, additional concepts can be learned.

5. Concept Map Project with Elementary Students

In a concept mapping project on the topic of geometry that I conducted with children ages 9-11, the following comments were heard (Gallenstein, 2011). "Oh, I see", explains one student. "It's like a domino effect. One word affects the other and then the other and then the other." "I need a match for this word" was followed by, "It's right here." And, "I've got angles", shared one child. Followed by, "I need angles right here", responded another. These comments were shared by fourth and fifth grade students while they investigated the topic of geometry through the construction of mathematics concept maps.

On two separate days, students in both a fourth and fifth grade class participated in a mathematics concept map activity centered on geometry. The activity served as a post-assessment for the fourth grade students and a pre-assessment for the fifth grade students. Both classroom teachers arranged their students into heterogeneous groups, with each group consisting of 3-5 students. The following materials were provided to each group.

Concept Map Materials:

- **Word cards**: Geometry; Shapes; Two Dimensional; Three Dimensional; Quadrilaterals; Trapezoid; Rhombus; Pentagon; Hexagon; Octagon; Parallelogram; Square Pyramid; Rectangular Prism; Sphere; Cylinder; Cube; Cone; Square; Rectangle; Triangular Prism; Face; Edge; Vertex; Flat side; One pair of parallel lines; Two pairs of parallel lines; Solid figure with length, width & height; Plane figure with length, width & height; Two faces meet; Three or more faces meet; Three sides; Four sides; Five sides; Six sides; Eight sides; Angles; Right angle; Acute angle; Obtuse angle; 90°; Greater than 0° and less than 90°; Greater than 90° but less than 180°; 4 right angles; 4 equal sides; One pair of parallel sides; Opposite sides equal & parallel; One picture each of a triangle, rectangle, square, pentagon, hexagon and octagon
- **Objects:** One pattern block each of a triangle, square, rhombus, trapezoid, hexagon, diamond/parallelogram; marble, dice; blue translucent plastic cube, square pyramid, rectangular prism, cylinder, sphere; rectangular prism cardboard food container, metal enclosed soup can
- **Concept Connectors:** 7-inch by 1-inch strips of white paper, 4-inch by 1-inch strips of white paper trimmed at one end to a point (arrows)

Before beginning the activity, both classes were provided with an overview of concept mapping and with basic instructions on how to design concept maps. Students were informed that there is no one right way to design a concept map, and that each group's final map may differ from the other versions. Pictures of two completed concept maps on different concepts were displayed in the classroom for reference.

As a class, students reviewed how to work as a cooperative learning group, while emphasizing that all ideas should be valued. After the groups were assigned space to work, each group was presented with an envelope of word cards. Students were then instructed to lay all of the word cards out for everyone in their group to see. Then, as a group, they were asked to decide on a concept card from their packet that could be placed at the top of their map. This word card would serve as the general concept that would include all of the other concept word cards. The students were then informed to sort the concept cards into groups in order to begin organizing their concept maps. Most groups, although making accurate connections, took more time to agree on the arrangement of the word cards and often changed the placement of the words when they felt they had a better idea. (See Figure 12.)

Figure 12. Geometry Assessment Project: Beginning to Organize Grade 5, Age 10

After the groups constructed fairly organized formats, pictures, pattern blocks, three-dimensional blue plastic translucent objects, and relevant objects were provided to each group. Because of the organization of their maps, some groups were easily able to place the shapes into their constructed maps. Other groups rearranged their maps somewhat to accommodate the shapes (See Figure 13). One student held up the marble and mentioned that her group had already been given a plastic sphere so they did not need the marble. She was encouraged to add the marble to their group's map. Her group then cleverly decided to place the marble inside the plastic sphere. They also placed the dice inside the plastic cube and then correctly positioned both the sphere and cube on their concept map. (See Figure 14.)

Figure 13. Geometry Assessment Project – Reorganizing to Fit Concrete Objects Grade 5, Age 10

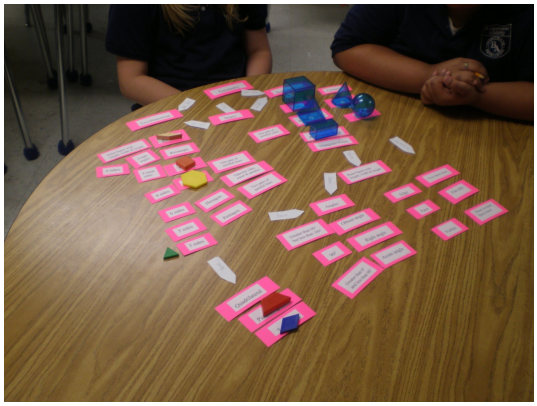

Figure 14. Geometry Assessment Project – Final Project Grade 4, Age 9

The shapes provided all of the groups with an opportunity to clarify their thoughts and solidify their connections with the concept word cards. After the shapes were provided, each group received a handful of paper strips and arrows that they could use to link the concepts together. Most of the linking words that the students chose to include in their concept maps were "has, is, are, can be, includes, equals, and measures". (See Figures 15 & 16).

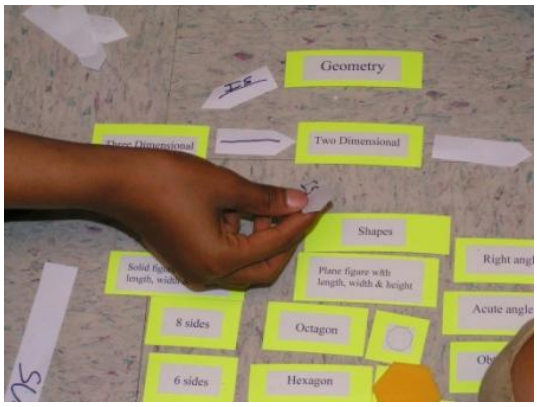

Figure 15. Geometry Assessment Project: Adding Linking Terms Grade 5, Age 10

Figure 16. Geometry Assessment Project – Adding More Linking Terms Grade 5, Age 10

After most of the work was completed and class time was nearing the end, volunteers in the fourth grade class were asked to read their concept maps aloud for their classmates. While each concept map was being read, all class members gathered around and followed along with what their classmates shared. In the fifth grade class, students as a group were asked to shift to a different group's concept map and investigate how each map was alike and different. Not only were the students in all of the groups able to see how the maps differed in concept connections and construction, the concept maps also served as reinforcement to their knowledge. For example, when reviewing one of the concept maps, one student pointed to one connection and exclaimed, "That's what we were trying to figure out." Another student was impressed with the other group's concept map and responded, "Wow!" In viewing another map, one student responded, "Yeah, they got it all. They got everything!" (See Figure 17.)

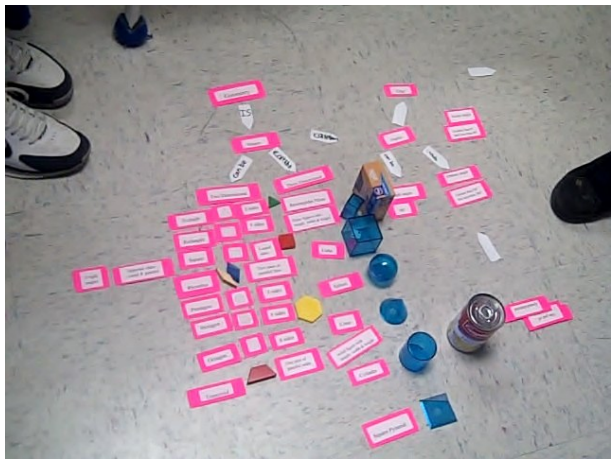

Figure 17. Geometry Assessment Project – Final Project Grade 5, Age 10

Teachers can use concept mapping as an effective learning tool for assessing their students' understandings through the creation of concrete and/or graphic/visual representations. Both of the teachers whose students participated in this concept mapping project witnessed first-hand the value of including concept mapping as a pre- and post-assessment tool in the mathematics curriculum. They have a clearer understanding of their students' needs in relation to understanding geometry and are better prepared to address them. Furthermore, both teachers commented on how enthusiastic their students were about their experiences with the concept mapping project. They also were very impressed with the level of success their students experienced with cooperation, organization, problem-solving, decision making and critical thinking.

6. Items to Consider When Constructing Concept Maps

1) Introducing Concept Mapping: In order to ensure success, when introducing concept mapping activities to preschool-grade 6 students, begin by constructing a group concept map. This can be completed on the chalk/white board, an overhead projector, an ELMO, a Smart Board, or by creating larger materials for a class project that could be constructed cooperatively on the floor.
2) Materials: Provide objects and word cards in which your students will experience success. Appeal to the concrete, pictorial/representational, and symbolic/abstract levels of your students. Start with a workable amount of materials. Later, challenge your students by adding more concepts to the pool of materials.
3) Space: When arranging students in groups, be certain that students have enough space to arrange all of their word cards and objects into a concept map. For example, students seated at a round table or on the floor are able to share easier and work more efficiently while those using their desk tops might struggle because of space constraints. Also, be certain that the students' workspaces are clear from distractions so the word cards and objects are clearly visible.
4) Group Size: Student participation is heightened when groups are smaller; 2-3 students per group would be appropriate.
5) Arrangement: If possible, arrange students in a "U" shape in order for them to fully participate and experience success with the activity. All students should be able to read and see the concept cards and objects while constructing the map.
6) Time: Be certain that you allow enough time for all students to become fully involved in the concept mapping process. Respect the various learning levels and abilities of your students. Consider placing the concept map materials in a learning center for further investigation.

7. Benefits of Concept Mapping Activities

Numerous benefits exist for learners as they participate in concept mapping activities. Teachers who promote the use of concept mapping techniques also benefit. Following, are ways in which both young students and their teachers benefit when concept mapping is incorporated into the curriculum (Gallenstein, 2003). Benefits for Students:

- Improves student concept constructions (Martin et al, 2001).
- Helps to clarify misconceptions.
- Connections between concepts provide for more meaningful learning.
- Provides opportunities to see logical connections between ideas.
- Provides opportunities for students to construct and make sense of their knowledge.
- Relates new material to previously acquired learning.
- Shows relationships among smaller and larger concepts (Martin et al, 2001).
- Organizes thoughts from general to specific.
- Acts as a motivator for learning while viewed as a game connecting ideas.
- Addresses all learning modalities: visual, auditory, tactile/kinesthetic.
- Associations and connections made between/among concepts.
- Builds self esteem as students experience success with various connections.
- Emphasizes diverse perspectives through the acceptance of various appropriate formats on the same topic.
- Provides opportunities for students to organize their thoughts and information in a concrete/visual format through grouping.
- Provides opportunities to sort and categorize information/topics.
- Promotes critical thinking skills such as observation, comparison, classification.
- Provides problem solving and decision making opportunities.
- Promotes and values both cooperative learning and independent work.
- Provides brainstorming opportunities.
- Reinforces and strengthens language and literacy skills.
- Strengthens communication skills.
- Provides opportunities for self-disclosure.
- Students learn that there are many correct ways to process similar information.
- Assists in developing an understanding of a variety of linking words that can connect concepts.
- Opportunities to express how concepts are linked while clarifying any misconceptions.

- Because concept map outcomes can differ, students build confidence in their personal abilities to express themselves (through links and cross links).
- Opportunities to communicate connections between different classes within the same category.
- Draws on personal experiences of how concepts connect.
- Provides opportunities to discover similarities in objects/pictures/words.
- Provides a concrete way for students to show mental connections between concepts in a similar category.
- Shows different relationships between ideas.
- Provides opportunities for students to manipulate concepts physically and mentally.
- Provides opportunities for students to play an active role in their learning by representing how concepts are connected.

Benefits for Teachers:

- Provides opportunities to analyze students' thinking.
- Can be used as a pre and post assessment instrument.
- Can be used to introduce or conclude a topic - or as an activity within a lesson/unit.
- Encourages educators to become more open minded and flexible with students' various interpretations and perspectives.
- Can be used as an organizer for units/lessons/activities.
- Used for both informal and formal assessment - formative and/or summative assessment.
- Allows a teacher to observe gaps in students' knowledge in order to facilitate correct conceptions (connections).
- Provides opportunities to implement new or additional learning experiences.
- Provides for various learning formats: whole class instruction, learning center, or interactive bulletin board.
- Used in many subject áreas.
- Provides opportunities for subject integration.

8. Concluding Thoughts

Concept mapping provides children with opportunities to become actively involved in their learning while linking knowledge to long-term memory. Through the use of concept maps, children have opportunities to organize their thoughts in a concrete and/or graphic/visual format, while connecting concepts and linking prior knowledge to new knowledge. Related concepts become connected rather than fragmented. Concept maps also provide children with opportunities to think about their own thinking as they reflect on their conceptual understandings. Additionally, teachers can use concept mapping as an effective learning tool for assessing learners' understandings through their creation of concrete and/or graphic/visual representations.

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