Using Thinking Maps to Develop Higher Order Thinking Skills among Diverse Learners

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Abstract

In today's era of testing and accountability in K-12 schools, it is imperative that teachers extend beyond teaching to the test. All students need to be taught how to think and organize information, which entails pedagogy that shapes and molds all learners into independent thinkers. Classrooms today are becoming increasingly diverse with children of varying abilities and disabilities, as well as cultural, language, and socioeconomic influences. Educators must be prepared to teach each child how to receive concepts and skills and then organize and understand this information logically, clearly, and functionally. Understanding the science of how a child interprets and organizes information is necessary for building sound pedagogical practices that allow the children to develop higher order thinking skills. Thinking Maps are a tool rooted in brain-based research that can be used to enhance students' higher order thinking skills while meeting the diverse needs of all of the learners.

Key terms: Thinking Maps, Higher Order Thinking, Brain-based Research

Much of the historical research surrounding teaching and learning emphasizes teacher knowledge and skills and their impact on student learning. However, more recent research involving the brain sheds light on how children learn (Calhoun, 2012). Such insight contributes to instructional strategies that effectively meet the needs of a diverse population of learners in the K-12 school setting. The purpose of this article is to examine aspects of brain-based learning that promote higher order thinking skills among the diverse population of students in today's schools, as well as to discuss the classroom implications for the use of Thinking Maps.

Brain-based learning uses findings from neuroscience research that open a window into how the brain takes in and processes information. Thus, neuroscience research can inform educators about the most effective ways to deliver and support instruction and educational experiences (Madrajo & Motz, 2005). Walker's (2015) review of the literature on brain-based learning revealed that the adolescent brain processes information in a parallel fashion, seeks patterns, and strives to connect new information to prior knowledge. As such, it is now imperative that educators and neuroscientists work together to maximize student learning through an understanding of how children learn (Calhoun, 2012).

According to Duman (2010), brain-based learning involves understanding how the brain processes and organizes information. Recent understandings from brain research suggest teachers should teach to individual students' differences using a variety of instructional strategies in order to increase student learning. Teaching in a variety of ways maximizes the uses and parts of the brain making them work together. Such instructional methods, in turn, allow teachers to more effectively teach diverse children who learn in a variety of ways and who have different learning abilities.

To investigate the effect of brain-based learning on student achievement, Gozuyesil and Dikici (2014) completed an extensive meta-analytical study. The authors analyzed 31 brain-based learning studies that investigated 42 effect sizes. Their analysis revealed that out of the 42 effect sizes, 35 of the studies revealed significantly positive effect sizes. Thus, the authors concluded that instruction grounded in brain-based learning had a positive effect on student learning. Calhoun (2012) concurred and noted that since children use their whole brains when engaged in learning experiences, it is imperative that teachers use a variety of strategies and experiences to accommodate the different learning modalities.

It is evident that students in the K-12 setting are diverse in how they prefer to take in, process, remember, and use information they learn (Madrajo & Motz, 2005). According to DeLorenzo (2011), the largest pathway that children learn through is visual and the second largest is auditory. Even learning styles has been a focus for brain-based learning. Duman (2010) investigated the effects of brain-based learning on the academic achievement of students with different learning styles. A pre-test/post-test experimental design compared the students' achievement tests scores. The results of the study revealed that students who received brain-based learning instruction had higher achievement scores than those who did not receive brain-based learning instruction.

Insight into how the brain takes in and processes information has also highlighted students' abilities to employ higher-level thinking. Smith (1992) defines higher order thinking skills as the complex thinking processes that include a variety of skills such as comparing, reasoning, analyzing, evaluating, synthesizing, and interpreting. When students use such skills in novel and unfamiliar situations, they are described as employing higher-level thinking. Budsankom, Sawangboon, Damrongpanit, and Chuensirimongkol (2015) noted three types of higher order thinking skills that include analytical, creative, and critical thinking. Additionally, Tishman, Jay, and Perkins (1993) noted that students who actively employ higher-order thinking skills possess a variety of characteristics including open-mindedness, the ability to plan, curiosity, inquisitive, conscientiousness, and the ability to think rationally and to self-monitor. Such insights have implications for teachers who must now employ the teaching and learning methodologies, principles, strategies, and techniques that establish and maintain a classroom environment that spurs and supports creative and critical thinking (Alberta Learning, 2002).

Increasing diversity among the K-12 student population is a challenge for today's classrooms. The National Council for Accreditation of Teacher Education (NCATE), defines diversity as differences among students based on ethnicity, race, socioeconomic status, gender, exceptionalities, language, religion, sexual orientation, and geographical area. However, learning experiences that spur higher levels of thinking and student achievement can mediate the differences listed above, particularly language differences. Incidentally, brain research and the many brain-based learning strategies available to teachers support such learning experiences. According to DeLorenzo (2011), Thinking Maps are one tool to provide visual support for the mental processes of diverse learners.

In the United States, the number of English Language Learners (ELL's) ages five to 17 rose dramatically between 1980 and 2009 from 4.7 to 11.2 million children (National Center for Education Statistics, 2011). Currently, there are at least 5.5 million ELL's in the nation's classrooms with 80% Latino (Zamora, 2007). While Spanish speaking children comprise 80% of the K-12 ELL population, other non-English languages are also present in America's classrooms. In all, ELL students speak over 450 languages. The top five languages spoken within our schools across the U.S. include Spanish, Vietnamese, Hmong, Cantonese, and Korean (Payan & Nettles, n.d.). ELL's makes up the fastest growing population in America. Seventy-six percent of elementary school ELL students and 56% of secondary school ELL students are American citizens and at least half of these children are descendants of generations of American citizens (Zamora, 2007).

Public school classrooms across America are not meeting the academic, and sometimes social, needs of the ELL students. In fact, many ELL children are over-identified as needing special education services in schools. This overrepresentation of ELL students in special education often impedes their academic achievement for several reasons. Among the reasons is the fact that the children actually in need of services do not receive them.

Additionally, the children who are misidentified as needing services no longer get exposure to the standard required curriculum taught in the regular classroom (Zamora, 2007).

So, what causes this over-identification of ELL children in special education? Many educators simply do not distinguish ELL's and special needs students due to their similar attributes. Several characteristics of special needs children are also present in ELL children, thus causing confusion and misdiagnosis. These attributes may include speech deficiencies, attention problems, poor reading abilities, and substandard vocabulary, as well as nonacademic traits such as anxiety, reclusiveness, and poor self-esteem (Zamora, 2007).

What are the implications for educators? First, teachers and administrators must develop an awareness of ELL's and their unique needs. ELL is not synonymous with special education. The language barrier is the first obstacle a teacher must tackle before being able to understand the child's cognitive abilities. A vast majority of ELL children who perform poorly academically do so not because of a cognitive disability, but because their teachers and administrators do not possess the tools and strategies needed to appropriately teach these children (Zamora, 2007).

In addition to ELL's, other diverse populations occur in classrooms such as children in poverty and special needs (gifted and SPED) students. According to the U.S. Department of Education, National Center for Education Statistics (2011), the number of children ages 3 to 21 who received special needs support and services in 2008-2009 was around six million. These students comprised 13.2% of the U.S. public schools' student population. Another large percentage of students in the classroom are those who come from low-socioeconomic families living in poverty. Members of different groups combined into one classroom can be challenging for the regular classroom teacher whose ultimate goal is to help each child succeed.

One way to meet the needs of diverse students in the classroom is to diversify teaching strategies to include visual tools that encourage the use of higher order thinking at all levels. Most of the information the brain takes in is visual (DeLorenzo, 2011). Thus, instructional strategies should enhance the brain's ability to make connections and construct meaning by providing visual anchors for abstract processes. Teachers should utilize research-based instructional strategies. Marzano, Pickering, and Pollock (2001) offer quality research-based instructional strategies that are effective for diverse populations of students. The strategies that will have the most significant impact on diverse students' learning include building vocabulary, graphic organizers, identifying similarities and differences, and note taking. These strategies are also most effective when implemented in the elementary school (Hayestead & Marzano, 2009).

As a means for helping teachers deliver many of the research-based instructional strategies in the classroom, Hyerle (1996) developed what is known as Thinking Maps. These Thinking Maps focus on eight cognitive processes that children across all grade levels need and use. These eight cognitive processes consist of defining in context, describing qualities, comparing and contrasting, categorizing, part-whole, sequencing, cause-effect, and seeing analogies. The goal of Thinking Maps is to provide a visual language for all children to see, apply, and automatize these cognitive processes (Burden & Silver, 2006).

Williams (2002) noted the importance of presenting diverse learners with a visual language that would guide and support thinking and problem solving. However, he went a step further and noted the importance of providing diverse learners with a consistent language to help them transfer their learning to tasks required for specific content areas. He concluded that teachers must employ the use of consistent terms, labels, visual representations, and demonstrations throughout the content areas to help diverse learners master the skills of using Thinking Maps (Williams, 2002).

The brain processes information by cataloging stimulation and organizing it with maps to form connections and make sense of acquired information (Clarke, 1991). These maps show individual components of an idea, as well as their relationship to other ideas and concepts. As tools for visually mapping what students read and write, Thinking Maps help learners organize, understand, and communicate information in a more accurate and efficient manner (Clarke, 1991). However, learning to organize such mental maps is not automatic. Students need visual outlines to help them see how bits and pieces of information connect to form a cohesive concept or idea. At the same time, students also need assistance from *experts* or those skilled in migrating or mapping knowledge and concepts into understandable and retrievable schemes (Novak & Gowin, 1984).

Hyerle (1996) developed eight visual tools that correspond to the specific thinking processes necessary for interpreting and understanding what is read and for accurately writing one's own ideas: circle map, bubble map, flow map, brace map, tree map, double bubble map, multi flow map, and bridge map. These tools allow learners to organize and map their thoughts and ideas about text, whether reading text or writing their own text. Circle maps allow users to define and list concepts and ideas within a specific context. Circle maps also facilitate the presentation of different points of views. Bubble maps describe qualities. Flow maps help students show the sequential relationship of events or steps. They present the flow of connections between events or ideas. Brace maps show part-to-whole relationships by allowing students to visualize a whole concept as it relates to its parts. A tree map shows the relationship between the main idea and supporting details. Tree maps also allow students to classify and group related ideas. The double bubble map facilitates the comparison and contrasting of qualities. Students can visualize similarities and differences, a skill that is vital to analyzing concepts and ideas. Multi flow maps aid students in identifying cause and effect relationships and helps them make logical predictions about outcomes. Finally, the bridge map helps students form and convey analogies (Burden & Silver, 2006).

Students learn how to match the Thinking Maps with the appropriate thinking task. As they use the maps, they are able to organize information in meaningful ways. As a result, the Thinking Maps enhance their understanding of ideas and concepts in such a way as to facilitate critical thinking and higher-level processing. Students should no longer be required to make abstract connections as best they can while reading and writing. Thinking maps can provide them with the concrete, visual representations on which they can precisely and proficiently interpret and generate text (Hyerle, 1996). When Thinking Maps support instruction, such instruction meets the needs of diverse populations since the maps provide a visual representation of ideas that correspond to auditory instruction.

According to Alikhan (2014), there are many benefits to using Thinking Maps for all learners. Thinking maps foster students' thinking and reasoning skills since they provide visual representations of cognitive processes. They visually represent the natural patterns developed in the brain thus making learning and understanding more meaningful. Their focus is on thinking skills and in-depth understandings and applies to grade levels and subject areas for all learners.

There is evidence of elementary schools using Thinking Maps across the nation to meet the needs of diverse learners, including ELL's. An example of the use of Thinking Maps to enhance ELL student learning is displayed in California. Roosevelt Elementary is an inner city school in California that serves a diverse group of students. All of the students receive free or reduced lunches and 85% of the students are considered ELL. Schools with such diverse students are often plagued with poor student achievement. However, Roosevelt Elementary is considered a Distinguished School in the state of California, largely due to the use of Thinking Maps (Holzman 2004). Thinking Maps provided a necessary means of communicating with ELL children since it reduces the need for communicating only in English. These maps transcend speaking and writing in English and promote higher order thinking skills in any language (Holzman, 2004). These maps not only provide ELL's with a strategy to encourage and promote thinking and communicating, but they also provide a means of assessing students' knowledge and conceptual understanding which is integral for reducing the over-identification of ELL's in special education.

Holzman (2004) utilized several different Thinking Maps to specifically meet her ELL students' needs; more specifically, she used the circle map and tree map. The purpose of circle maps is to expand and describe attributes, characteristics, and connections to a key term or phrase. The teachers used circle maps to show everything they know about nouns. Children were able to bring in pictures or words of nouns and add to their circle maps. This continuous opportunity for the use of words and pictures to expand on the concept of nouns assists ELL students in concept and vocabulary development through the use of visuals and graphic organizers. The purpose of a tree map is to classify and organize typically in a hierarchical fashion relevant to main ideas and ideas. Tree Maps allow children to organize information and then communicate the concepts to others. For example, children could read a text and identify the main idea and supporting details. Regular classroom children could then write a paragraph pertaining to the outlined information on the tree map. However, teachers could assess ELL students' understanding of organizing information and main ideas and details by reviewing outlines ELL students create with the use of Tree Maps. This form of differentiation allows teachers to make informative decisions about children's understanding of concepts, particularly ELL's (Holzman, 2004).

New York is the location of another example of the use of Thinking Maps for ELL students. Several of the New Rochelle City Schools in New York implemented Thinking Maps to improve instruction and subsequent student achievement specifically for its ELL's.

Students with limited English proficiency comprised 13% of the student population. The Thinking Maps provided visual tools that effectively supported higher levels of thinking and learning for students who did not speak English or were not yet proficient with English (Alper & Lopez, n.d.). The schools introduced the Thinking Maps in bilingual classrooms. The students responded with evidence of increased understanding. They were able to comprehend the content in deep ways that prompted the teachers to ask higher-level questions and engage students in complex discussions of the content. In 2006, the third through fifth grade students achieved 80% proficiency in English Language Arts, a feat that represented remarkable growth in student achievement (Alper & Lopez, n.d.).

In order to provide valuable resources for disadvantaged, poverty stricken students, such as ELL's and students from other diverse backgrounds, the United States Department of Education established what is known as the Title I federal program. Title I schools are schools that receive Title I federal funding (Ryan & Cooper, 2010). Hickie conducted a study in three particular Title I schools to determine a connection between Thinking Maps instruction and fifth grade students' reading and math achievement over a two-year period. The quasi-experimental study compared students' scores on the Tennessee Comprehensive Assessment Program (TCAP) who received Thinking Maps instruction to those students' TCAP scores who did not receive Thinking Maps instruction. The results indicated a significant difference in reading language arts scores on the TCAP for those students who received Thinking Maps instruction compared to those who did not (Hickie, 2006). This study suggests that economically disadvantaged students can make significant gains in reading achievement through the use of Thinking Maps.

Blount (1998) conducted a similar study over a four-week period using 17 fourth grade diverse, inner city students who read well below grade level. The purpose was to determine if Thinking Maps instruction affected these students' overall reading achievement, their ability to retain information, and their writing skills. The results of the study showed gains in overall reading achievement as seen through the administered pre-test and post-test. Students made progress in specific areas of reading including sequencing and identifying details. Students also improved their writing abilities, specifically in the areas of organization and including descriptive details (Blount, 1998). This study also showed that visual aids, such as Thinking Maps, can help foster academic achievement for ELL's as well as students with special needs.

Visual tools are an essential instructional aide when working with special needs students (Manning, 2003). Children with special needs require additional services in school settings. Special education services in schools supply the additional services. Just as teachers facilitate achievement among all regular education students, teachers must also facilitate learning gains among special needs students. As such, special needs children benefit from strategies that help students visualize thinking processes because the strategies support and facilitate learning for academically challenged children. Both special needs children and diverse learners also benefit from visual, multi-sensory learning experiences (Gately, 2008).

According to Manning (2003), the use of Thinking Maps resulted in substantial increases in the achievement scores of special needs students as indicated by the Massachusetts Comprehensive Assessment System (MCAS) scores. Thinking maps across all subject areas were introduced to over 300 students with special needs across all grade levels in a school in eastern Massachusetts at the beginning of the school year in September. In December of the same school year, students completed the Massachusetts Comprehensive Assessment. The assessment results showed that special needs children's reading comprehension skills improved after receiving Thinking Maps instruction. Other areas of improvement for special needs children included concept attainment, recall of information, overall motivation and creativity, and improved writing skills.

Thinking Maps have also proven effective with international children with special needs. Mashal and Kasirer (2011) noted that Israeli children with special needs benefited from the use of Thinking Maps. Prior to administering thinking maps instruction, they assessed children with autism (ASD) and children with learning disabilities (LD) on their knowledge of figurative language and homophones. The post- test results indicated that when the LD group encountered metaphors for the first time, they used thinking maps to understand them more efficiently than the ASD group. Furthermore, in the autistic group the homophone meaning generation test, associated with mental flexibility mechanism, correlated with novel metaphors understanding, which do not rely on prior knowledge. Overall, the students with special needs demonstrated increases in their abilities to understand figurative language and homophones.

Diverse student populations, such as students with special needs, ELL's, as well as students from other disadvantaged backgrounds, should be taught through the use of effective, research-based instructional tools, such as Thinking Maps.

As the literature demonstrates, the academic achievement of these students can improve significantly by using them. Students will learn to apply concepts, think more critically, and process information more efficiently in various content areas if teachers utilize the Thinking Maps that correspond to the eight cognitive processes.

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