EASTERN NAZARENE COLLEGE

DIVISION OF GRADUATE STUDIES
DIVISION OF TEACHER EDUCATION

IMPROVING READING COMPREHENSION THROUGH VISUAL TOOLS

By

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Abstract

Reading comprehension in learning disabled students can be increased with the classroom implementation of visual tools. Student performance was measured using MCAS reading scores before and after the introduction of Thinking Maps, i.e., a set of visual tools which are centered on the development of eight thinking processes. By integrating this common visual language throughout the school's curriculum, it was projected that more effective and efficient learning would be achieved. Assessment results indicated that reading comprehension was increased; it was also observed by classroom teachers that levels of performance rose overall in the following areas: concept attainment, reflective thinking, recall, retention, writing (quantity and quality), creativity, motivation, and cooperative learning skills. These findings are congruent with a multitude of research studies and support the position that student performance can be increased with the implementation of visual tools.

List of Related Vocabulary

Massachusetts Comprehensive Assessment System (MCAS): a high stakes achievement test that determines eligibility for graduation in the state of Massachusetts (Massachusetts Department of Education, n.d.).

Fluency: "Reading smoothly, quickly, and with expression" (Tomkins, 2003, 506).

Graphic organizers: "Diagrams that provide organized, visual representations of information from texts" (Tomkins, 2003, 506).

Scaffolding: "The support a teacher provides to students as they read and write" (Tomkins, 2003, 507).

Visual tools: Visuals "such as organizers, webs, and thinking-process maps" (Hyerle, 2000, 1) which "show patterns of thinking" (Hyerle, 2000, vi).

Thinking Maps: "Eight visual tools based on [the eight] fundamental thinking skills" (Hyerle, 2000, book jacket); maps include Circle Map, Bubble Map, Double Bubble Map, Tree Map, Brace Map, Flow Map, Multi-flow Map, and the Bridge Map (Hyerle, 2000, 108).

Circle Map: Thinking Map used for "representing and brainstorming ideas, defining words by showing context clues, and identifying audience and author's point of view" (Hyerle, 2000, 108).

Bubble Map: Thinking Map used for "expanding descriptive vocabulary, describing characters using adjectives, and providing descriptive details for writing" (Hyerle, 2000, 108).

Double Bubble Map: Thinking Map used for "comparing and contrasting characters, prioritizing essential characteristics, and organizing a compare-and-contrast essay" (Hyerle, 2000, 108).

Tree Map: Thinking Map used for "identifying main idea, supporting ideas, details; organizing topics and details for writing; and taking notes for lectures and research papers" (Hyerle, 2000, 108).

Brace Map: Thinking Map used for "comprehending physical setting in stories, analyzing physical objects from technical reading, and organizing and writing technical manuals" (Hyerle, 2000, 108).

Flow Map: Thinking Map used for "sequencing story plot by stages and substages, analyzing and prioritizing important events, and sequencing paragraphs for writing" (Hyerle, 2000, 108).

Multi-flow Map: Thinking Map used for "analyzing causes-effects in literature, predicting outcomes from previous events, and organizing 'if-then' persuasive writing" (Hyerle, 2000, 108).

Bridge Map: Thinking Map used for "comprehending analogies, similes, and metaphors; preparing for testing using analogies; and developing guiding analogies for writing" (Hyerle, 2000, 108).

Strategies for Improving Reading Comprehension

Reading is the foundation for life-long learning. One must be able to master this skill in order to facilitate the learning process. Yet reading is simply not enough; one must be able to understand what one has read and be able to apply the newly acquired knowledge for the benefits to be fully realized.

In America, reading is taught mainly using a basal approach, involving "teacher directed [methodology] with a significant reliance on worksheets, rote learning, and minimal interaction of students" (Kirylo and Millet, 2000, 179). This teaching method has been proven to be only minimally effective, as students do not retain much of what they have read and incorrectly comprehend the material. Two goals of a successful reading program are that students must be able to read on their own and understand what they have read. Teachers, likewise, must become better educators by learning and implementing reading comprehension strategies that will help students reach their goals (Kirylo and Millet, 2000, 180).

One of the challenges which teachers face is how to present information that can be processed successfully by students, particularly those who are categorized as *special needs*. Perhaps the most abstruse task for learning disabled students to execute is making connections with content in textbooks. Texts are not organized for the learning disabled; any student who is a passive learner, or one who "lack[s] skills for processing and organizing written and oral information" (DiCecco and Gleason, 2002, 306), requires explicit instruction and assistance with "making inferences, understanding relationships and connections, distinguishing main ideas from significant details, and understanding the gist of the passage" (DiCecco and Gleason, 2002, 306).

Students typically read a chapter and answer comprehension questions relating to that chapter. Rarely are they given guidance or strategies on how to "decipher text structure and interpret information" (DiCecco and Gleason, 2002, 306). Learning disabled students need a repertoire of strategies, coupled with explicit instruction, to assist with the comprehension of information.

Ciardello writes that, in 1999, an Adolescent Literacy Commission established by the International Reading Association announced that a study they conducted found students lacking in reading skills, including comprehension, summarization, and conceptualization. The commission recommended all middle school and high school teachers teach comprehension across the curriculum. Social studies specifically posed the most significant challenge, due to the abstract method in which complex information is presented in history textbooks. Students are not able to independently read and process a typical social studies textbook, as they have difficulty comprehending the generalized, conceptual patterns of text structure. Consequently, students perceive history to be a collection of non-related events and facts; because of insufficient comprehension, they cannot establish connections between these events and facts (2002, 31). The most common—albeit problematic—text structure patterns in textbooks which have emerged are "hierarchical, time order, cause/effect, description, and comparison/contrast"; according to Ciardiello, these five thinking processes pose the most significant obstacle to adolescent students

(2002, 31).

Students must grow into independent learners; the role of a teacher is to facilitate the transfer of knowledge that makes this goal possible. Since most learning across the curriculum involves reading at various levels, comprehension strategies are particularly important, yet they are rarely taught in a regular classroom; it is assumed that students intuitively know how to understand what they are reading and that comprehension is an automatic skill. In addition, most textbooks present knowledge in a linear mode; in order for students to be able to perceive non-linear relationships, teachers must take advantage of newer, visual approaches (Chang, Sung, and Chen, 2002, 5).

A comprehension strategy promoted by Fournier and Graves is scaffolding, or "providing support to help learners bridge the gap between what they know and can do and the intended goal" (2002, 31). According to Bransford, Brown, and Cocking, scaffolding is one of the most effective instructional procedures. When teachers utilize scaffolding techniques in the classroom, they will cue, question, coach, corroborate, and provide basic information. If it were not for the teachers' facilitation, students would not otherwise be able to complete a task or activity by themselves (Fournier and Graves, 2002, 31).

For many learning disabled students, scaffolding alone is not adequate. Visuals can be an additional, powerful tool to help process and link facts with events. One visual tool that has been proven to work for over thirty years is the graphic organizer; this successful strategy helps sort information and breaks it down into manageable pieces which can then be processed by passive learners. Graphic organizers clearly portray connections between main categories and sub-categories that textbooks fail to establish explicitly (DiCecco and Gleason, 2002, 306). Research confirms their effectiveness when utilized in curriculum planning, assessment, determining student knowledge and misconceptions, and evaluating learning as well as instruction. They enable students and teachers to have an overall snapshot and make connections between concepts, ideas, or categories; another benefit is their flexibility and their ability to be modified or added to as necessary. Graphic organizers can be completed by each student working alone or in groups, or they can be used by an educator to teach a lesson (Irwin-DeVitis, Modle, and Bromley, 1990, 54-57). By creating these visual tools, students become "the engineers of their own investigation" (Irwin-DeVitis, Modle, and Bromley, 1990, 54). Irwin-DeVitis, Modle, and Bromley list six ways in which a teacher can make graphic organizers work in the classroom (1990, 54-57):

- Plan your teaching.
- Tap into students' interests.
- Uncover misconceptions.
- Record data.
- Assess learning.
- Evaluate your instruction.

Chang, Sung, and Chen (2002, 5-6) consider graphic organizers to be a highly beneficial, spatial learning strategy. They affirm that:

> the structure of the whole text and the interrelations between concepts are illustrated with a visual method that gives the readers a clearer, more substantial understanding of what is being read.... Text structure and content is easier to retain and retrieve...; impressive results [are achieved] in assisting the reader in memorization and comprehension of text content.

Graphic organizers help students read better by making reading “an active process in which they can build a bridge between prior knowledge and new information” (Kirylo and Millet, 2000, 180). According to Kirylo and Millet,

> activating prior knowledge is critical to the success of obtaining meaning from the text.... Learners relate new knowledge to what they already know, thus assimilating the new information. The construction of graphic organizers encourages the organization of ideas, words, and concepts, assists in making meaningful patterns and connections, and facilitates comprehension and retention of new text. (2000, 182-183)

Spatial formats are a successful strategy that facilitate the integration of scaffolding with visuals in order that information may be sorted and broken down into manageable pieces, thus enabling it to be processed by passive learners. Such visual tools clearly portray connections between main categories and sub-categories that textbooks fail to establish explicitly. Or, by completing a graphic organizer as a pre-reading exercise, the teacher can assist the student in retrieving prior knowledge that is critical in establishing the connection between prior knowledge and new concepts. Students are likewise introduced to the reading material in a manner that develops interactive and interpersonal skills (DiCecco and Gleason, 2002, 306).

Research has proven that students retain and retrieve information better when a graphic organizer, rather than an outline, is used, since a graphic organizer is deposited in one's memory much like a picture is stored (Katayama and Robinson, 2000, 120). Kulhavy, Lee, and Caterino have found that "storing text information in both spatial and verbal formats… provide[s] the student with an additional retrieval path for recalling the information…. Two routes are better than one" (Katayama and Robinson, 2000, 120). For students who do not fill out a graphic organizer with useful or thorough information, an option is for the teacher to pass out a partially-constructed graphic organizer. The students know precisely what is expected of them, yet they benefit from constructing the organizer themselves (Katayama and Robinson, 2000, 123).

One needs to understand the importance of using graphic organizers before attempting to use them in the classroom. They "communicate both vertical, hierarchical concept relations… and horizontal, coordinate concept relations… that are essential for successful content application to occur" (Robinson, Katayama, DuBois, and Devaney, 1998, p. 17). Winn found that "students may extract more information from a quick glance at a spatial display than they can from a longer viewing of a linear display," such as an outline or general chapter notes; it was also discovered that students "found information needed to answer questions faster than when they searched outlines or texts" (Robinson, Katayama, DuBois, and Devaney, 1998, p. 18 and 21). Graphic organizers "facilitate learning of concept relations… in an efficient, spatial format that can be easily searched for information… like [an organized] library… [instead of] one where books are randomly stacked *in piles*" (Robinson, Katayama, DuBois, and Devaney, 1998, p. 21).

There are numerous methods that facilitate reading comprehension and assist students with determining the meaning of what has been read. Graphic organizers which address sequencing, summarization, questioning, and predicting skills are four of the most effective strategies (Bereiter and Bird, 1985). The Wisconsin Literacy Education and Reading Network (n.d.) have identified six essential reading strategies and graphic organizers that support these strategies (see Appendix E):

- *Making connections*: KWL (what do you know, what do you want to know, and what have you learned), brainstorming, and LINK (list, inquire, note, know)
- *Questioning*: KWL, "w" word charts
- *Visualizing*: guided imagery, story maps, story pyramids
- *Inferring*: questioning the author, question/answer columns
- *Determining importance*: KWL, story maps, highlighting
- *Synthesizing*: Thinking Maps, writing templates, column notetaking

Imagine if one had an innovative strategy that would raise test scores significantly, that would help one think more clearly and concisely, that would enable one to "construct, organize, assess, and convey knowledge" even better than a graphic organizer (Hyerle, 1995, 85). There exists a new visual tool published in 1995 called *Thinking Maps* that claims to accomplish these goals, although limited research has been conducted on their actual efficacy. Thinking Maps' creator, D. Hyerle, professes that these enhanced visual tools help students learn more effectively and efficiently; lessons reportedly can be taught in less time with increased retention (Hyerle and Curtis, 2001).

Fifteen years ago, Hyerle discovered that students could complete semantic maps such as brainstorm webs and graphic organizers, but they were unsure of what to do with this information once they had written it down, i.e., they were unable to develop it into a well-organized essay (1995, 85). He studied human thought process and established that spatial formats which address every thinking process could be utilized to "generate and organize… thoughts and ideas, either on paper or by using… software" (Hyerle, 1995, 85). He called these visual tools *Thinking Maps* and began implementing them as comprehension aids at all educational levels, in kindergarten through the twelfth grade (Hyerle, 1995, 85).

Hyerle writes:

> students may exit our schools with the ability to read text, but not build meaning. Our students' *cognitive skills* development—the foundation of every school's goals or mission statement—are randomly supported, rarely raised to the level of fluency, and nearly absent as a distinct dimension of assessment.… And, as we know from our brain research, we must facilitate the *patterning* of content knowledge as a foundation

> for learning. Thinking Maps, as a language of visual tools based on fundamental thinking skills, has been proven as one route for unifying content and process instruction, and assessment of products. (2000, 102)

Hyerle had realized that humans no longer think exclusively in linear patterns. He acknowledges that Thinking Maps help students become independent, motivated learners and enable students and teachers to see what the students are thinking. Flexibility is one benefit to using the maps; they may be adapted in complexity for the student who is using them (Hyerle, 1995, 86-88). Hyerle believes that the principal reason for their success is due to the fact that that they are "a common visual language among students and between students and teachers" (1995, 87-88).

A relevant issue to explore is how Thinking Maps differ from other visual tools, including graphic organizers and brainstorm webs. Graphic organizers are geared towards isolated tasks, as they are highly structured and task-specific; students simply are required to fill-in a worksheet. Webs are more flexible than graphic organizers, allowing the student to record personal knowledge about a topic in an adaptable format. Thinking Maps combine the task-specific structure of a graphic organizer with the flexibility of a web, enabling the student to transfer thinking processes and develop a common visual language that is shared by other students and teachers (Hyerle and Curtis, 2001).

What exactly does this mean? Thinking Maps are based on the eight fundamental thinking skills that everyone possesses: define, describe, compare and contrast, classify, divide a whole into parts, sequence, cause and effect, and see relationships. Once students master these eight thinking skills, they are taught how to apply these thinking processes in order to solve problems using Thinking Maps; students then are able to transfer thinking skills across content areas. Thinking Maps are especially unique because, unlike graphic organizers and webs, maps can be used by teachers to teach lessons, they can be used by students as a learning activity, and they can be used as reflective or developmental learning assessment tools by students and teachers alike. Thinking Maps alone develop higher level, critical thinking skills because they complement and promote the eight thinking processes. A student does not just record information—he or she comprehends and manipulates it using metacognitive skills, i.e., a student is required to think about thinking in order to understand and complete the map (Hyerle and Curtis, 2001). "The consistency and flexibility of each of the Thinking Maps promotes student-centered and cooperative learning, concept development, reflective thinking, creativity, clarity of communication, and continuous cognitive development" (Hyerle, 1995, 89).

The question then arises: are Thinking Maps truly effective in aiding reading comprehension? Substantial research asserts the effectiveness of graphic organizers, yet little officially has been published on Thinking Maps. To be deemed credible, claims must be validated and backed up by proof. When directly asked as to why this dearth of empirical data exists, B. Singer of Innovative Learning Group responded that Hyerle's initial focus has been on promotion of the maps; she states that with increased funds will come the money to back research studies (personal communication, December 18, 2002).

The most substantial proof of Thinking Maps' effectiveness has been the considerable rise in test scores in many schools where Thinking Maps have been introduced, particularly when tracked over several years. At the Margaret Fain Elementary School in Atlanta, Georgia, reading scores on the 1996 Georgia State Test of Basic Skills improved by 40% in just one year, with mathematical scores showing a parallel rise of 31%. Thinking Maps achieve such optimal results when implemented comprehensively across the curriculum on a school-wide basis; many other schools have demonstrated similarly large gains in testing scores (Hyerle, 2000, 134).

One of these schools that recently has noticed substantial increases in test scores is a school in eastern Massachusetts. Children who have documented, moderate, language-based learning disabilities receive specialized educational services at this educational institution's elementary, middle, and high schools; currently there are over 300 students from 91 towns across Massachusetts, New Hampshire, and Rhode Island who attend classes there. In September 2002, Thinking Maps were introduced in every grade and in every subject, including counseling, speech, and occupational therapy sessions; shop classes; and electives. Each Thinking Map first was introduced in the students' Language Arts classes, allowing one week for introductory exercises; other content areas reinforced the map the following week after its introduction. Maps which addressed higher-level thinking processes with complex cognitive development typically took an additional week for further reinforcement across the curriculum; student progress was monitored continuously to ensure that students were able to internalize the maps and become fluent with the thinking processes.

By December 2002, the Massachusetts Comprehensive Assessment System (MCAS) Retest had been administered, and all but one Thinking Map (the Bridge Map, which the school's students found to be the most abstract and difficult) had been introduced. During the administration of the test, nearly every student used Thinking Maps to organize written information on Language Arts and Mathematics open response questions as well as on the Literature portion of the exam. When the MCAS Retest scores arrived in March 2003, the school's administrators were able to credit significantly improved test scores to Thinking Maps exclusively, as no other variables had been introduced during the academic year, and all classes followed the standard pattern which they have followed the last several years and to which returning students have grown accustomed.

After interpreting 2002 MCAS Language Arts Retest scores, administrators noted that reading comprehension was increased substantially, as evidenced by the rise in scores from *0* and *1* to *3* and *4* (ranging from low to high comprehension ratings); in previous years, out of a field of approximately 45 students, only a few students would score an occasional *3*, and a *4* was even more rare, if it even appeared at all. On the 2002 MCAS Language Arts Retest scores, out of a field of 41 students, 13 students scored at least one *3* (and no higher) on an open response question, and 20 students scored at least one *4*, indicating that comprehension had increased to passing levels for 33 out of 41 students.

With regards to the 2002 MCAS Mathematics Retest scores, out of a field of 56 students, 5 students scored at least one *3* (and no higher) on an open response question, and 24 students scored at least one *4*, indicating that comprehension had increased to passing levels for 29 out of 56 students.

The school's students had utilized Thinking Maps as tools for processing and organizing information on the MCAS exam, and the benefits were apparent in their overall scores (see Appendix A). In previous years, a minor percentage of students passed each test; the majority failed. On the 2002 MCAS Language Arts Retest, however, 28 students passed, and 13 failed. Out of the 13 who failed, 8 students came within two points of a passing score. Twenty-six students passed, and 31 failed the 2002 MCAS Mathematics Retest. Seven students came within two points of a passing score, out of the 31 who failed.

Since September 2002, student performance at this school has improved as demonstrated by an increase in vocabulary acquisition, concept attainment, an ability to make connections, and an ability to establish relationships (see Appendix C). The students' overall learning process has been facilitated by the use of these visual tools (see Appendix B). Using Thinking Maps, students have able to develop cognition and comprehension strategies in order that they may bridge the gap between current and projected abilities. As evidenced by the 2002 MACS Retest scores, Thinking Maps have proven to be an integral tool for students to retain and retrieve content, attain concepts, and forge connections. Teachers' fluency with Thinking Maps is tracked as well, to ensure that students are receiving the maximum benefit possible (see Appendix F).

In lieu of extensive published research, and in addition to increased test scores as reported by many districts, one also could interpret the fact that over 3,000 schools worldwide implement Thinking Maps into their curriculum as evidence that they must work to some degree (B. Singer, personal communication, December 18, 2002).

Reading is elemental for learning; one must be able to master comprehension in order to facilitate knowledge acquisition. Rote teaching methods have proven to be only minimally effective, as students typically do not retain much of what they have read and incorrectly decode the material. This dilemma necessitates that educators change their teaching methods to include strategies that address the development of reading comprehension skills, including retention and retrieval, thus helping students become independent learners.

The past thirty years have yielded a significant amount of research supporting the use of graphic organizers with all student populations to assist with reading comprehension and decoding text structure. Research has demonstrated that visual tools are a viable instructional strategy that enables students to attain concepts and establish connections requisite for proficiency, and that they are an integral component of successful teachers' repertoires of instructional methodologies.

Whichever strategy is utilized, one factor remains constant, the importance of using some kind of strategy. As students rarely are able to grasp key concepts and understand content independently, strategies can prove to be invaluable tools for helping students construct meaning from text. When educators are armed with such tools, research corroborates that students, in fact, can make substantial gains in reading comprehension.

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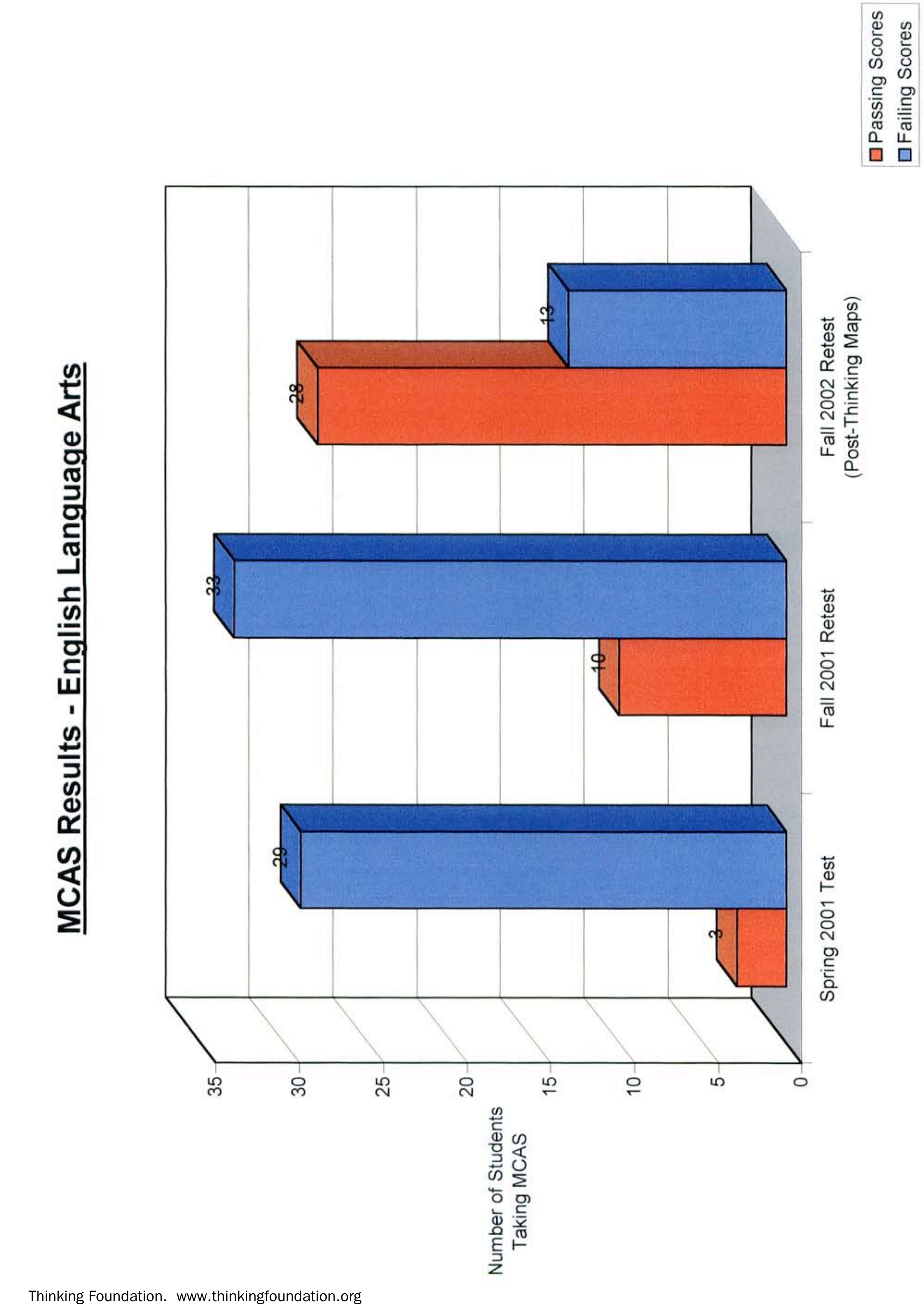
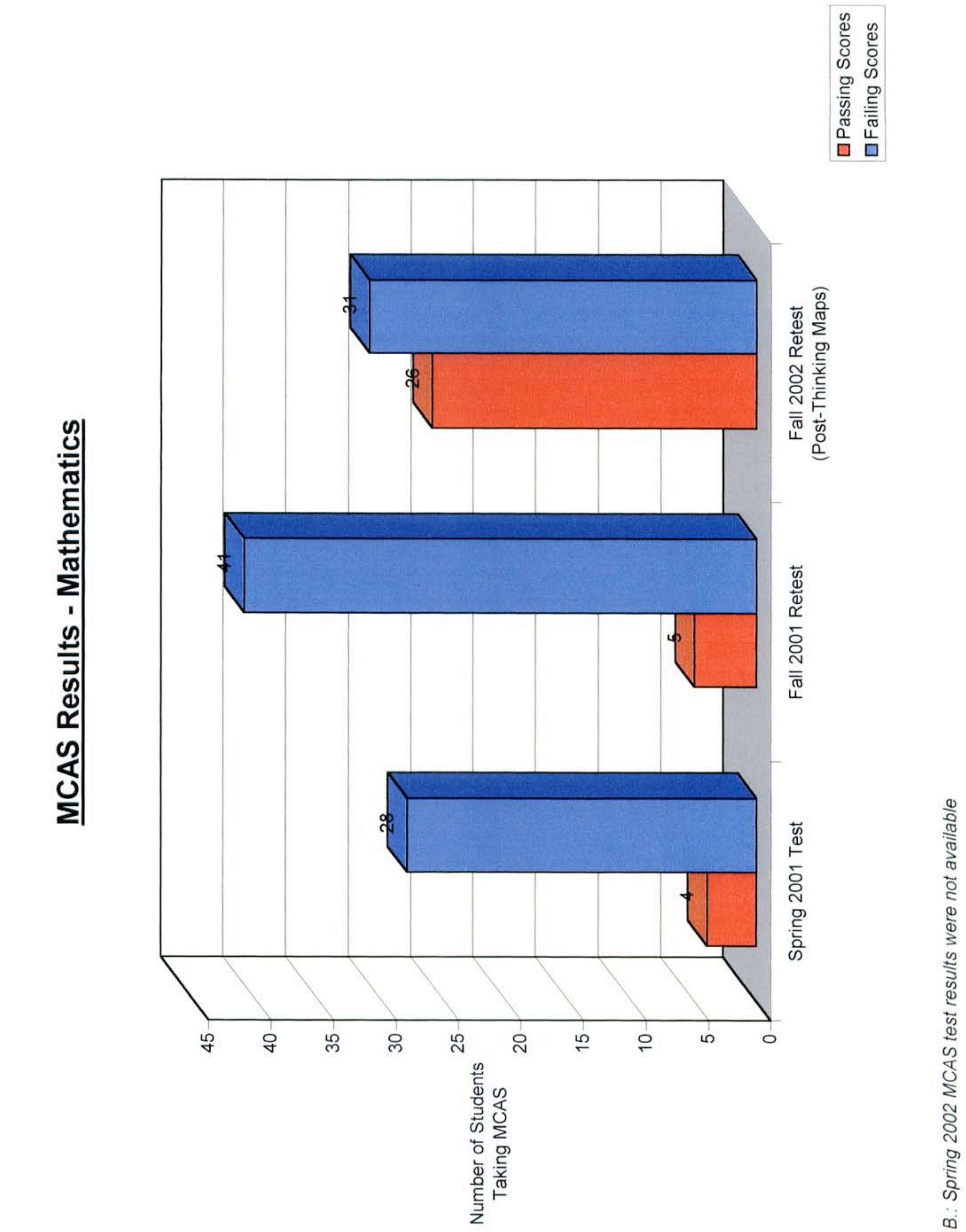
Appendix A

Following are an eastern Massachusetts school's MCAS results for the past three tests; MCAS results for Spring 2002 were unavailable.

MCAS Results - English Language Arts

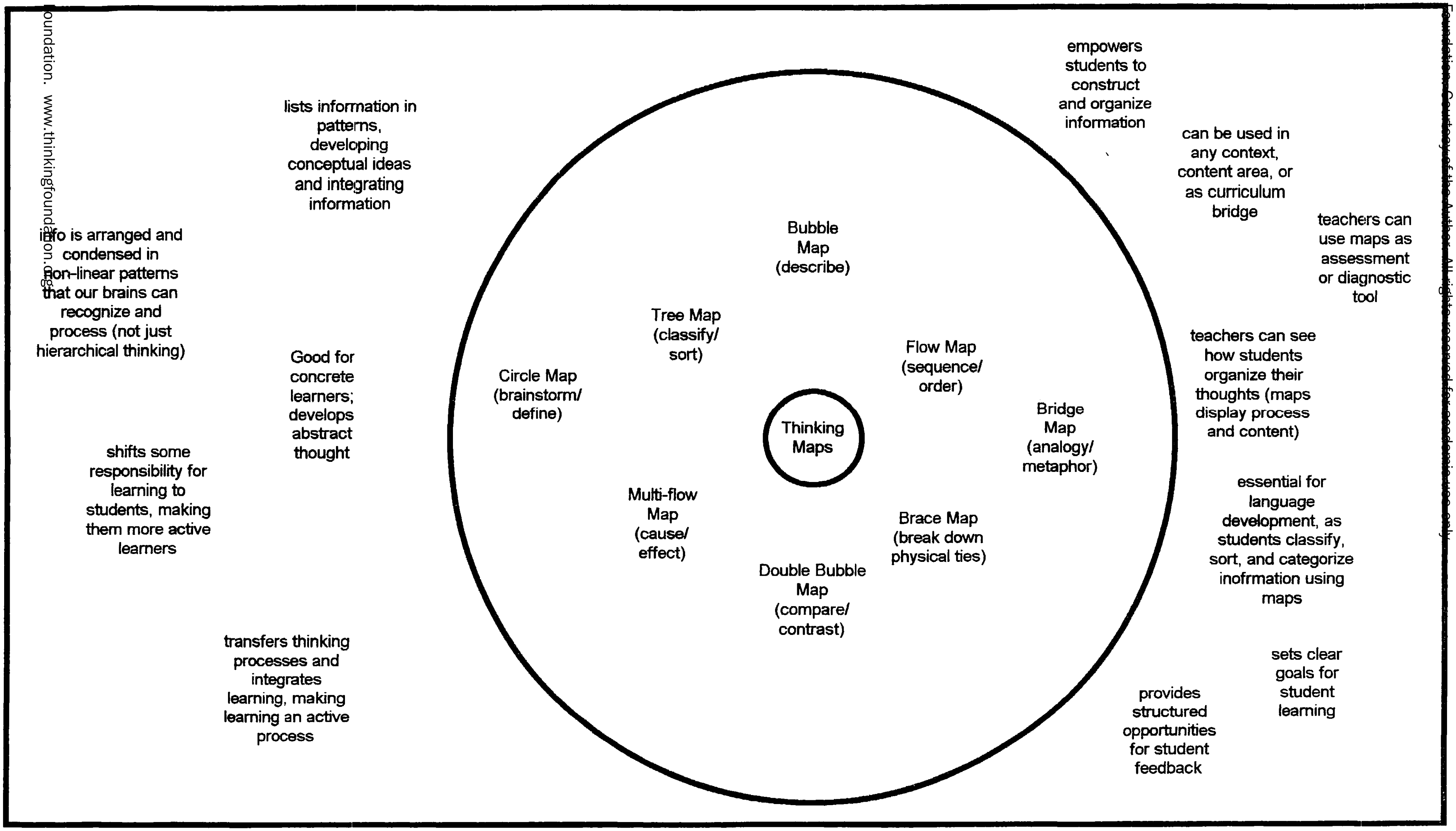


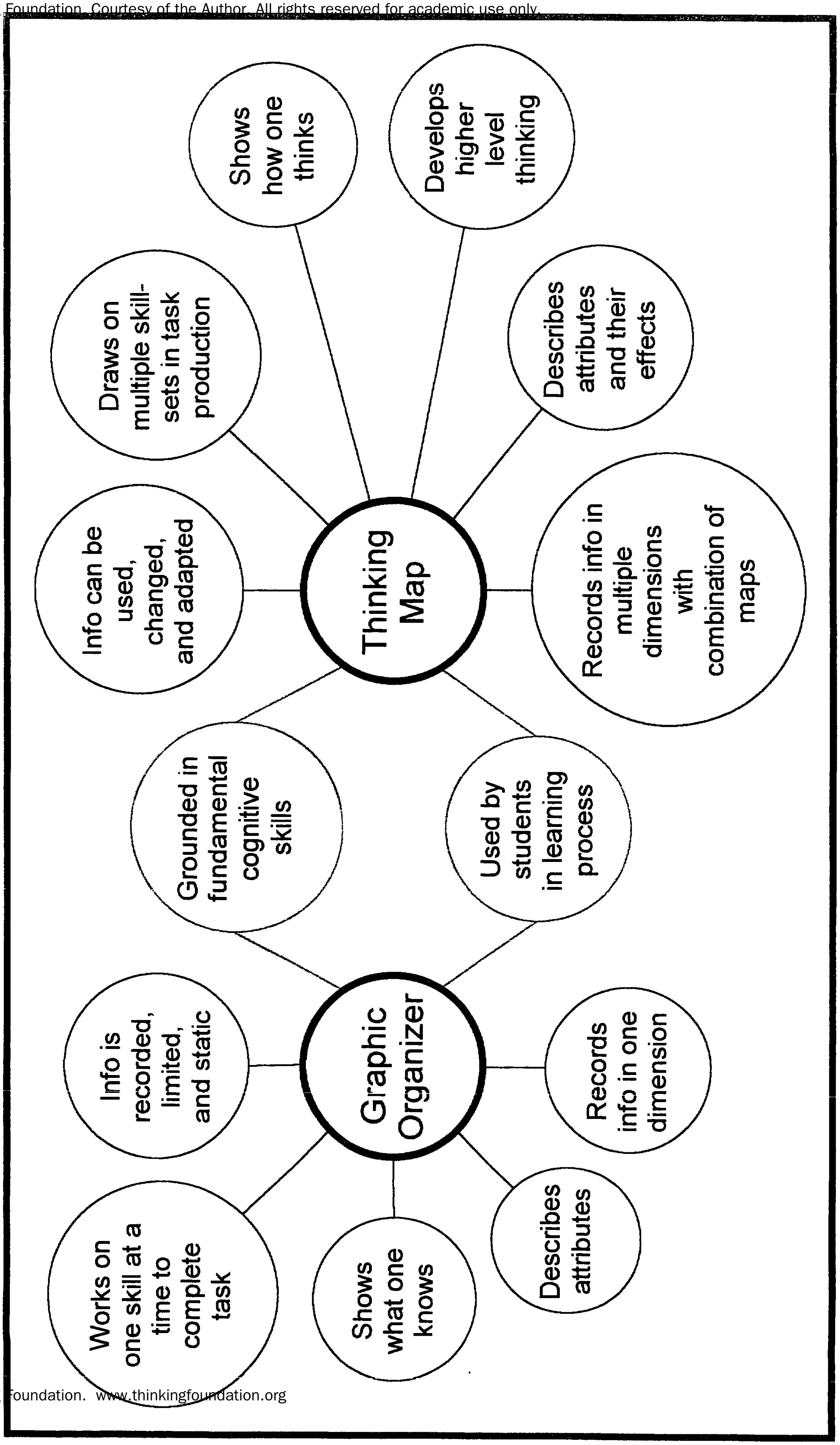
N.B.: Spring 2002 MCAS test results were not available


MCAS Results - Mathematics
Number of Students Taking MCAS
0
5
10
15
20
25
30
35
40
45
4
28
5
41
26
31
Spring 2001 Test
Fall 2001 Retest
Fall 2002 Retest (Post-Thinking Maps)
Passing Scores
Failing Scores
N.B.: Spring 2002 MCAS test results were not available

Appendix B

Sample Thinking Maps that were completed at the school in eastern Massachusetts follow; some maps have been constructed using “black line worksheets,” or graphic organizer-type handouts. These starter maps were drawn during the introduction phase of Thinking Maps (September 2002 – January 2003). Most students now are expected to construct the maps independently; dysgraphic students are encouraged to utilize Thinking Maps software when drawing maps (samples of which also are included).


Thinking Maps
Bubble Map (describe)
Flow Map (sequence/ order)
Bridge Map (analogy/ metaphor)
Brace Map (break down physical ties)
Double Bubble Map (compare/ contrast)
Multi-flow Map (cause/ effect)
Circle Map (brainstorm/ define)
Tree Map (classify/ sort)
empowers students to construct and organize information
can be used in any context, content area, or as curriculum bridge
teachers can use maps as assessment or diagnostic tool
teachers can see how students organize their thoughts (maps display process and content)
essential for language development, as students classify, sort, and categorize inofrmation using maps
sets clear goals for student learning
provides structured opportunities for student feedback
lists information in patterns, developing conceptual ideas and integrating information
info is arranged and condensed in non-linear patterns that our brains can recognize and process (not just hierarchical thinking)
Good for concrete learners; develops abstract thought
shifts some responsibility for learning to students, making them more active learners
transfers thinking processes and integrates learning, making learning an active process


Thinking Map
Shows how one thinks
Develops higher level thinking
Draws on multiple skill-sets in task production
Describes attributes and their effects
Info can be used, changed, and adapted
Records info in multiple dimensions with combination of maps
Grounded in fundamental cognitive skills
Used by students in learning process
Graphic Organizer
Info is recorded, limited, and static
Records info in one dimension
Works on one skill at a time to complete task
Shows what one knows
Describes attributes