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Thinking Technology

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Topics to be discussed:

- uniting networking capacities in the brain, mind, and machines
- making the explicit connection between higher-order thinking and technology applications
- using a common language of thinking patterns through software for mapping the standards

BRAIN, MIND, AND THE MACHINE

It seems odd to think that soon we will be celebrating the 25th anniversary of the personal computer in public schools. I remember loading programs from the cassette drive on TRS-80s and Commodore PET machines. I was even impressed that I could write a five-line program in BASIC and have my name show up all over the screen. From the time I was an elementary school teacher beginning to use technology, to when I took a position as a districtwide technology coordinator, to my present work as the state director of the Gates Leadership Program, New Hampshire School Administrators Leading with Technology (NHSALT), I have been part of and have observed with a critical eye the slow and, more recently, rapid progression of technology use in our classrooms.

The computer, in one of its earliest and simplest definitions, is an input, process, and output device. Many of these early computers were described as "thinking machines" that would ultimately mimic the sensory input, mental processing, and productive output of the human mind. Artificial intelligence programs were being created to challenge chess champions at a time before the intelligence quotient was being challenged and before a theory of multiple intelligences was offered. This was also a time when the brain was described as a black box, simply broken down into two separate hemispheres, and before we had the new functional MRI brain scanning tools that show that "holism" is a more accurate description of the complex circuitry of the human mind-brain.

When working with computers, our neurons accept visual input through the optic nerve, and our brain processes all of the shapes, colors, and bits of information at lightening speed. An interaction occurs between the user (a strange slang often linked to the addicted) and the machine: a transfer or exchange of data. Amazement and wonder take over. The wiring and firing of neural pathways in the brain is readied as we try to relate to and make conscious sense of the data before us. What does this mean? Thousands of calculations that would take us weeks to accomplish by hand, the ability to accept variables and build projections, answers, answers, and more answers. Think of the possibilities, think of the impact on education, think of . . .

WAIT! HOLD ON. WHAT IMPACT ON EDUCATION?

Now here's a question worth spending some time on. Schools have spent billions of dollars on wires, boxes, routers, hubs, displays, calculators, probes, and printers. Despite this effort and expense, at a time of high-stakes testing, accountability, and financial benefits from research-based best practices, few can respond with deep data when the words "show me the research" are uttered.

There is no way to tie computers to improved student outcomes without taking a great leap of faith. Just to say "kids love computers" gets us only half way. So where can we begin to examine the connections and the impact of technology on higher-order thinking skills?

Jamie McKenzie (2003), a long-time leader and critical reviewer of educational technology, emphasizes that students need to be "info-tectives," savvy with a set of problem-solving tools and adept at moving information around and seeing information in different forms and from different points of view.

One of the keys to instruction and learning is the visual domain. Bridging technology to graphic representations is not something new. In fact, the two fields intimately overlap. Beyond a few bells and whistles and maybe downloaded music playing backup, most of the output from the computer is visual. This means that technology, graphic representations, and the human brain with its dominant visual nature are uniquely bound by visual representations, a meshing of circuitry.

Inspiration and OmniGraffle are now commonly used software programs for webbing and creating visual organizers for content-specific tasks and processes. These are highly flexible, open-ended graphical software programs, with infinite template starters. However, the critique of graphic overload as students and teachers are inundated with graphic organizers (Hyerle, 2000) is mirrored in the graphical creations on these software programs: There are so many graphics that the cognitive load on students (not to mention teachers) ultimately outweighs the benefit. There is little theoretical coherence to most graphic organizers as they show up in many basal texts and books of graphic organizers, and the same is true for graphical software programs through which an infinite number of graphics can be spun out on the screen.

Many of these graphics serve only one aspect of Bloom's taxonomy: They simply capture the factual knowledge within preformed organizational structures that have no real connection to fundamental thinking processes. Often these graphics structure the thinking for students rather than offering students flexible tools that can support them in consciously performing at higher levels of thinking. Chris Moersch (2002) refers to this as "chroming" a lesson: just adding something for the sake of using technology, but not bringing the lesson to any new levels of thinking.

TECHNOLOGY FOR THINKING

As education continues to identify best practices, and cognitive scientists discover more about how people learn and the workings of the brain, educators must focus efforts on delivering quality educational opportunities with tools that are common and transferable to learners in a variety of environments. *Thinking Maps Software* (Hyerle & Gray Matter Software, 1998) having evolved out of the language of Thinking Maps®, is one pathway toward this outcome.

When I started working with teachers and technology through the use of Thinking Maps and *Thinking Maps Software,* I was amazed that, given the same set of tools, first graders and eighth graders were sharing ideas about writing styles of authors. When the work was displayed in a hallway, third-grade students, not familiar with the sixth-grade content, could name the cognitive process that was being used to communicate information through a common Thinking Map. Students were given tools that organized their thinking, allowed them to communicate their thinking, and were motivated by the ability to create graphic representations of their thinking on the computer. We were creating a culture of thinking in our schools that integrated technology as part of the center of the community, improved pedagogy, and promoted thinking.

As a technology coordinator, I saw new effective communication across content areas and grade levels as parents, teachers, and students used a common visual language to teach and share complex thoughts and ideas. We offered *Thinking Maps Software* training to parents. Some parents attended formal instruction in the evening at school, and many parents experienced informal sessions, with their children providing examples and teaching them how to use the software in the labs at schools. Not only were students sharing maps with parents, but parents were sending maps to teachers! Administrators included maps in newsletters to describe processes for student placement. They also used maps to explain the results of programs on high-stakes tests. At open house, parents and children were in front of computers exploring the various uses of the maps. We even had parents bring in examples of maps that they created to be used in their workplace. This seemed to be an integration point, a crossroads for best practices focusing on higher-order thinking, a delivery system using the personal computer, and a common visual language built on the cognitive processes embedded in Thinking Maps. This also produced a systemic change across one of the schools, Hanover Street School, that resulted in improved scores for students on the New Hampshire statewide test.

ELEMENTS OF THINKING MAPS SOFTWARE

Thinking Maps, a visual language, offers common symbols or elements, a flexible structure, and is easily communicated and transferable in the learning community. For teachers, *Thinking Maps Software* creates in the computer environment relevant activities to what is being used in the classroom. By the nature of the visual language, a Thinking Map asks students to define in context, sequence, compare or contrast, describe, identify whole-to-part relationships, determine cause and effect, create or identify analogies, or classify information. Planning units or developing lesson plans takes on a deeper focus when the cognitively based maps are used as a tool to inform instruction. The software is designed for both teachers and students through a three-window approach: a window for lesson planning for the teacher, a window for the dynamic generation of Thinking Maps by students, and a final window for students to transfer their Maps into writing (see Figure 9.1) In the software environment, teachers can use the tools in the same way as students, or they can create plans and assessments or capture and collect evidence of success that can be shared with other educators.

The software is a simple tool that can be used in very complex ways. The software allows for the flexibility to edit, rearrange, highlight, and embed thoughts and ideas throughout the learning.

This means that the students are actively engaged and can interact with the information over time. Just as with word-processing programs, which enable highly flexible movement of text blocks and facilitate editing to create multiple versions of a piece of writing, the software gives students and teachers a common platform for re-visioning information. They can continually return to expand the maps as they assimilate new content knowledge or to transform the maps as they reconceptualize ideas.

From the Individual to the System in New York City

One inner-city school system took the step to use Thinking Maps to unite teaching, learning, and the standards through the software. Community School District 27 in New York City was the largest of the city districts (before a recent reorganization) and was set in a diverse, low socioeconomic area near Kennedy Airport. Nearly 160 languages and dialects are spoken throughout this region. Many of the 37 elementary and junior high schools in the district were underachieving, and the standards movement was just on the horizon. During the 1997 school year—after piloting and evaluating several approaches—the district adopted Thinking Maps as one way to help students, teachers, and schools through this process. With the support and guidance of Ken Grover, Deputy Superintendent of Community School District 27, by the year 2000, most of the teachers had experienced Thinking Maps through direct training.

As an end-of-the-year assessment, all teachers were asked to submit examples of student work and their lesson design, with the New York City Standards that were being met clearly identified on the top of each page. Lynn Kanter, a former reading specialist who became the districtwide Thinking Maps coordinator, produced a compilation of over 400 pages of standards-based Thinking Map lessons spanning all content areas and grade levels . . . all hard copy.

As teachers collected student work and designed engaging activities that integrated technology, the district team facilitated a database development so that any teacher could tap the success of another teacher throughout the district and even see a sample of the type of work generated by a variety of students. *Mapping the Standards* (Curtis, in press) was a pilot for the district, enabling it to continuously build an electronic database of successful learning experiences based on fundamental cognitive processes. The database of selected, high-quality lessons is searchable based on the standard(s) being met, grade, and curriculum area. Figure 9.1 is a partial example of how the three windows enable teachers to create standards-based essential questions, based on thinking processes and leading to the development of Thinking Maps, with a piece of writing as a final product.

The importance and implications of this project are multifold. As teachers experienced success, they were able to communicate the process they used to deliver the instruction, capture evidence of student work, and provide reflections or ideas about the learning they experienced. Within a school, teachers could build a dynamic library of successful lessons and activities that they know work. District 27 then began to share these lesson and maps with teachers throughout the district. Teachers began to dialog and discuss student work and pedagogy. Lessons could be opened up adopted, modified, and exchanged without hard copy, using *Thinking Maps Software*. This is not global "curriculum mapping" but detailed mapping of content-based thinking skills units of study and content standards.

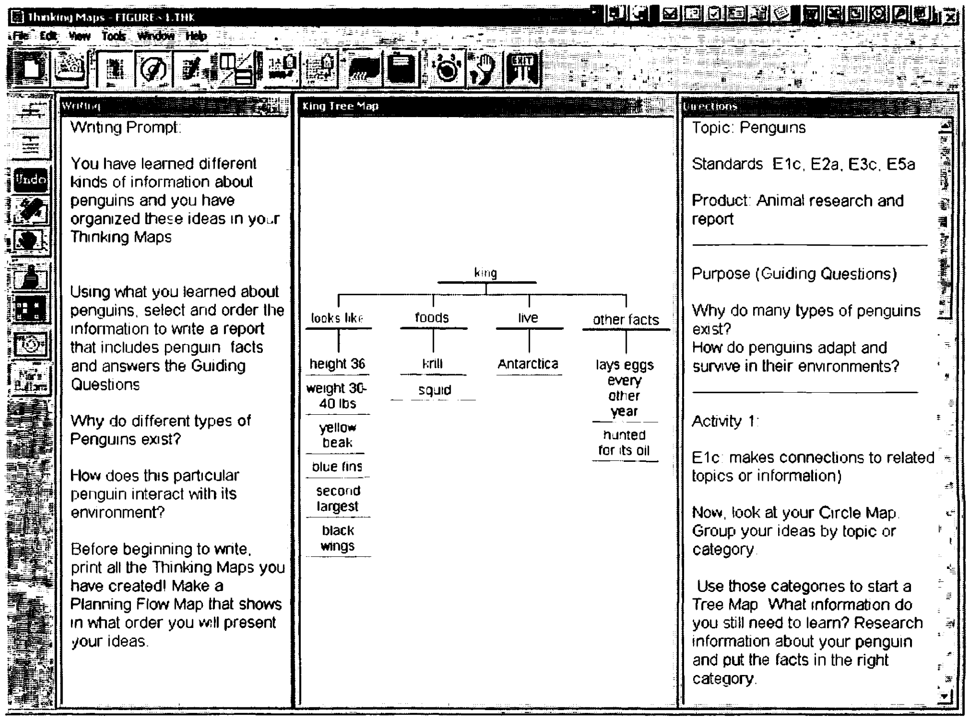

Figure 9.1 Thinking Maps Software With Mapping the Standards

Evolution

Technology in the classroom is still in its infancy. For some teachers in District 27, this was the first time they had used a software program that was directly related to teaching practices and based on something that they were already using interactively in their classrooms. The software thus became a technology for learning, connected to the classroom and teaching experience and not a disconnected process of learning a new technology.

Within our educational systems, advancements in the use of technology must combine with the necessary advancements in school climate, instructional practices, and instructional leadership. It will be in these high-functioning, well coordinated environments that our students will have the greatest opportunity to succeed. Thinking Maps and *Thinking Maps Software* comprise a set of tools to integrate technology with pedagogy focused on higher-order thinking with the potential to create positive, systemic change in education. The dynamic visual circuitry of Thinking Maps creates an overlap between the human brain and the technology of the computer. They provide a crossroads, a nexus between brain, mind, and machine for efficiently and effectively organizing, understanding, and communicating thinking within a classroom, across whole schools, and around the world.