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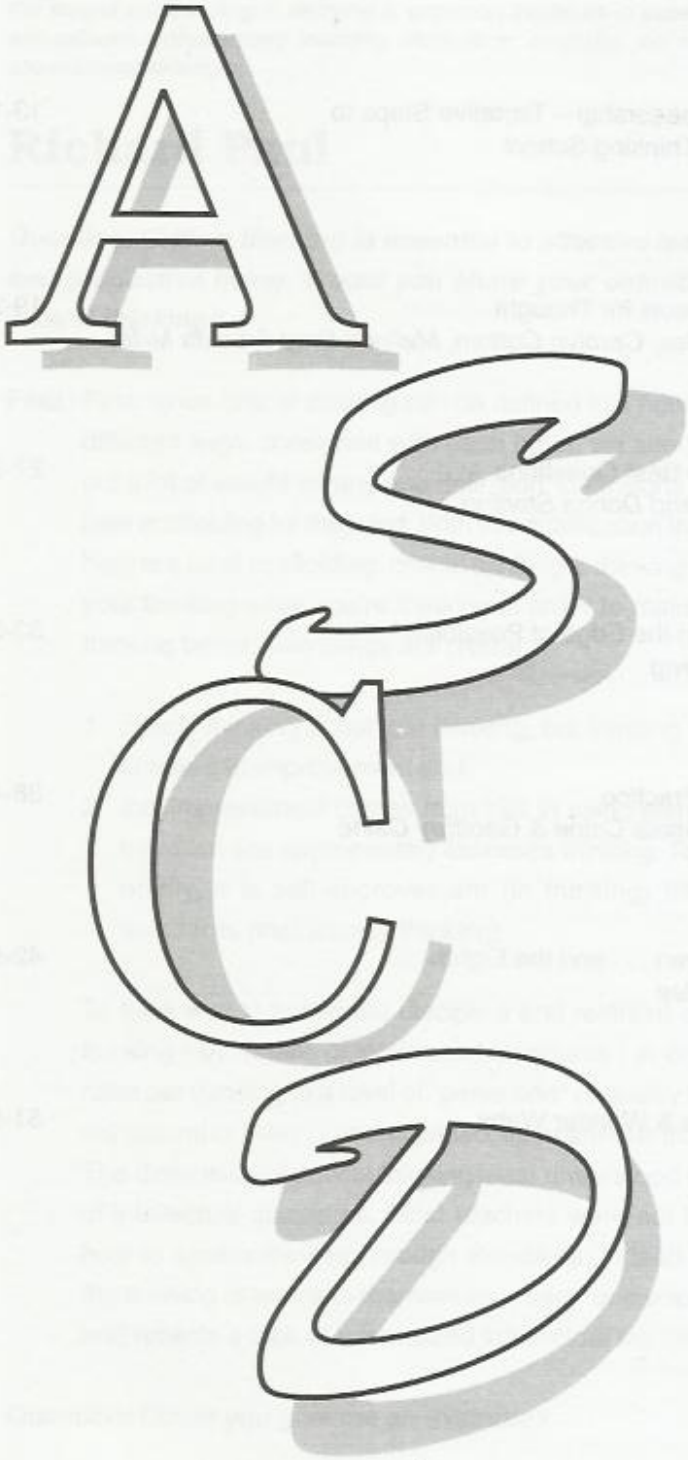
Thinking & Learning

ASSOCIATION FOR SUPERVISION AND CURRICULUM DEVELOPMENT (SINGAPORE)



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Thinking and Learning

contents

Critical Thinking: Basic Questions and Answers

In this interview for Think magazine (April '92), Richard Paul provides a quick overview of critical thinking and the issues surrounding it: defining it, common mistakes in assessing it, its relation to communication skills, self-esteem, collaborative learning, motivation, curiosity, job skills for the future, national standards, and assessment strategies.

Richard Paul

Question: Critical thinking is essential to effective learning and productive living. Would you share your definition of critical thinking?

Paul : First, since critical thinking can be defined in a number of different ways consistent with each other, we should not put a lot of weight on any one definition. Definitions are at best scaffolding for the mind. With this qualification in mind, here is a bit of scaffolding: critical thinking is thinking about your thinking while you're thinking in order to make your thinking better. Two things are crucial:

1 critical thinking is not just thinking, but thinking which entails self-improvement and
2 this improvement comes from skill in using standards by which one appropriately assesses thinking. To put it briefly, it is self-improvement (in thinking) through standards (that assess thinking).

To think well is to impose discipline and restraint on our thinking - by means of intellectual standards - in order to raise our thinking to a level of "perfection" or quality that is not natural or likely in undisciplined, spontaneous thought. The dimension of critical thinking least understood is that of intellectual standards. Most teachers were not taught how to assess thinking through standards; indeed, often the thinking of teachers themselves is very "undisciplined" and reflects a lack of internalized intellectual standards.

Critical thinking is thinking about your thinking while you're thinking in order to make your thinking better.

Question: Could you give me an example?

Paul: Certainly, one of the most important distinctions that teachers need to routinely make, and which takes disciplined thinking to make, is that between reasoning and subjective reaction.

If we are trying to foster quality thinking, we don't want students simply to assert things; we want them to try to reason things out on the basis of evidence and good reasons. Often, teachers are unclear about this basic difference. Many teachers are apt to take student writing or speech which is fluent and witty or glib and amusing as good thinking. They are often unclear about the constituents of good reasoning. Hence, even though a student may just be asserting things, not reasoning things out at all, if she is doing so with vivacity and flamboyance, teachers are apt to take this to be equivalent to good reasoning.

This was made clear in a recent California state-wide writing assessment in which teachers and tester applauded a student essay, which they said illustrated "exceptional achievement" in reasoned evaluation, an essay that contained no reasoning at all, that was nothing more than one subjective reaction after another. The assessing teachers and testers did not notice that the student failed to respond to the directions, did not support his judgement with reasons and evidence, did not consider possible criteria on which to base his judgement, did not analyze the subject in the light of the criteria, and did not select evidence that clearly supported his judgement. Instead the student described an emotional exchange asserted - without evidence - some questionable claims expressed a variety of subjective preferences. The assessing teachers were apparently not clear enough about the nature of evaluative reasoning or the basic notions of criteria, evidence, reasons, and well-supported judgement to notice the discrepancy. The result was, by the way, that a flagrantly mis-graded student essay was showcased nationally (in ASCD's Developing Minds), systematically misleading the 150,000 or so teachers who read the publication.

If we are trying to foster quality thinking, we don't want students simply to assert things; we want them to try to reason things out on the basis of evidence and good reasons.

Question: Could this possibly be a rare mistake, not representative of teacher knowledge?

Paul: I don't think so. Let me suggest a way in which you could begin to test my contention. If you are familiar with any thinking skills programs, ask someone knowledgeable about it the "Where's the beef?" question, namely, "What intellectual standards does the program articulate and teach?" I think you will first find that the person is puzzled about what you mean. And then when you explain what you mean, I think you will find that the person is not able

The idea is not to help students to make more inferences but to make sound ones, not to help students to come up with more analogies but with more useful and insightful ones.

to articulate any such standards. Thinking skills programs without intellectual standards are tailor-made for mis-instruction. For example, one of the major programs asks teachers to encourage students to make inferences and use analogies, but is silent about how to teach students to assess the inferences they make and the strengths and weaknesses of the analogies they use. This misses the point. The idea is not to help students to make more inferences but to make sound ones, not to help students to come up with more analogies but with more useful and insightful ones.

Question: What is the solution to this problem? How, as a practical matter, can we solve it?

Paul: Well, not with more gimmicks or quick-fixes. Not with more fluff for teachers. Only with quality long-term staff development that helps the teachers, over years not months, to work on their own thinking and come to terms with what intellectual standards are, why they are essential, and, how to teach for them. The city of Greensboro, North Carolina has just such a long-term, quality, critical thinking program. So that's one model your readers might look at. In addition, there is a new national organization, the National Council for Excellence in Critical Thinking Instruction, that is focused precisely on the articulation of standards for thinking, not just in general, but for every academic subject area. It is now setting up research-based committees and regional offices to disseminate its recommendations. I am hopeful that eventually, through efforts such as these, we can move from the superficial to the substantial in fostering quality student thinking. The present level of instruction for thinking is very low indeed.

Question: But there are many areas of concern in instruction, not just one, not just critical thinking, but communication skills, problem solving, creative thinking, collaborative learning, self-esteem, and so forth. How are districts to deal with the full array of needs? How are they to do all of these rather than simply one, no matter how important that one may be?

Paul: This is the key. Everything essential to education supports everything else essential to education. It is only when good things in education are viewed superficially and wrongly that they seem disconnected, a bunch of separate goals,

a conglomeration of separate problems like so many bee-bees in a bag. In fact, any well-conceived program in critical thinking requires the integration of all of the skills and abilities you mentioned above. Hence, critical thinking is not a set of skills separable from excellence in communication, problem-solving, creative thinking, or collaborative learning, nor is it indifferent to one's sense of self-worth.

Question: Could you explain briefly why this is so?

Paul: Consider critical thinking first. We think critically when we have at least one problem to solve. One is not doing good critical thinking, therefore, if one is not solving any problems. If there is no problem there is no point in thinking critically. The "opposite" is also true. Uncritical problem solving is unintelligible. There is no way to solve problems effectively unless one thinks critically about the nature of the problems and of how to go about solving them. Thinking our way through a problem to a solution, then, is critical thinking, not something else. Furthermore, critical thinking, because it involves our working out afresh our own thinking on a subject, and because our own thinking is always a unique product of our self-structured experience, ideas, and reasoning, is intrinsically a new "creation", a new "making", a new set of cognitive and affective structures of some kind. All thinking, in short, is a creation of the mind's work, and when it is disciplined so as to be well-integrated into our experience, it is a new creation precisely because of the inevitable novelty of that integration. And when it helps us to solve problems that we could not solve before, it is surely properly called "creative".

The "making" and the "testing of that making" are intimately interconnected. In critical thinking we make and shape ideas and experiences so that they may be used to structure and solve problems, frame decisions, and, as the case may be, effectively communicate with others. The making, shaping, testing, structuring, solving, and communicating are not different activities of a fragmented mind but the same seamless whole viewed from different perspectives.

Critical thinking is not a set of skills separable from excellence in communication, problem-solving, creative thinking, or collaborative learning, nor is it indifferent to one's sense of self-worth.

Question: How do communication skills fit in?

Paul: Some communication is surface communication, trivial

Where communication becomes part of our educational goal is in reading, writing, speaking and listening. These are the four modalities of communication which are essential to education and each of them is a mode of reasoning. Each of them is shot through with critical thinking needs.

communication - surface and trivial communication don't really require education. All of us can engage in small talk, can share gossip. And we don't require any intricate skills to do that fairly well. Where communication becomes part of our educational goal is in reading, writing, speaking and listening. These are the four modalities of communication which are essential to education and each of them is a mode of reasoning. Each of them is shot through with critical thinking needs. Take the apparently simple matter of reading a book, has taken some ideas and in some way represented those ideas in extended form. Our job as a reader is to translate the meaning of the author into meanings that we can understand. This is a complicated process requiring critical thinking every step along the way.

- What is the purpose for the book?
- What is the author trying to accomplish?
- What issues or problems are raised?
- What data, what experiences, what evidence are given?
- What concepts are used to organize this data, these experiences?
- How is the author thinking about the world?
- Is her thinking justified as far as we can see from our perspective?
- And how does she justify it from her perspective?
- How can we enter her perspective to appreciate what she has to say?

All of these are the kinds of questions that a critical reader raises. And a critical reader in this sense is simply someone trying to come to terms with the text. So if one is an uncritical reader, writer, speaker, or listener, one is not a good reader, writer, speaker, or listener at all. To do any of these well is to think critically while doing so and, at one and the same time, to solve specific problems of communication, hence to effectively communicate.

Communication, in short, is always a transaction between at least two logics. In reading, as I have said, there is the logic of the thinking of the author and the logic of the thinking of the reader. The critical reader reconstructs (and so translates) the logic of the writer into the logic of the reader's thinking and experience. This entails disciplined intellectual work. The end result is a new creation; the writer's thinking for the first time now exists within the reader's mind. No mean feat!

Question: And self esteem? How does it fit in?

Paul: Healthy self-esteem emerges from a justified sense of self-worth, just as self-worth emerges from competence, ability, and genuine success. If one simply feels good about oneself for no good reason, then one is either arrogant (which is surely not desirable), or, alternatively, has a dangerous sense of misplaced confidence. Teenagers, for example, sometimes think so well of themselves that they operate under the illusion that they can safely drive while drunk or safely take drugs. They often feel much too highly of their own competence and powers and are much too unaware of their limitations. To accurately sort out genuine self-esteem requires, yes you guessed it, critical thinking.

Question: And finally, what about collaborative learning? How does it fit in?

Paul: Collaborative learning is desirable only if grounded in disciplined critical thinking. Without critical thinking, collaborative learning is likely to become collaborative mis-learning. It is collective mis-learning. It is collective bad thinking in which the bad thinking being shared becomes validated. Remember, gossip is a form of collaborative learning; peer group indoctrination is a form of collaborative learning; mass hysteria is a form of speed collaborative learning (mass learning of a most undesirable kind). We learn prejudices collaboratively, social hates and fears collaboratively, stereotypes and narrowness of mind, collaboratively. If we don't put disciplined critical thinking into the heart and soul of the collaboration, we get the mode of collaboration which is antithetical of education, knowledge, and insight.

So there are a lot of important educational goals deeply tied into critical thinking just as critical thinking is deeply tied into them. Basically the problem in the schools is that we separate things, treat them in isolation and mistreat them as a result. We end up with a superficial representation, then, of each of the individual things that is essential to education, rather than seeing how each important good thing helps inform all the others.

Without critical thinking, collaborative learning is likely to become collaborative mis-learning. It is collective mis-learning.

To flourish, curiosity must evolve into disciplined inquiry and reflection. Intellectual curiosity . . . can help broaden, deepen, sharpen our minds, making us better, more humane, more richly endowed persons.

Question: One important aim of schooling should be to create a climate that evokes children's sense of wonder and inspires their imagination to soar. What can teachers do to "kindle" this spark and keep it alive in education?

Paul: First of all, we kill the child's curiosity, her desire to question deeply, by superficial didactic instruction. Young children continually ask why. Why this and why that? And why this other thing? But we soon shut that curiosity down with glib answers, answers to fend off rather than respond to the logic of the question. In every field of knowledge, every answer generates more questions, so that the more we know the more we recognize we don't know. It is only people who have little knowledge who take their knowledge to be complete and entire. If we thought deeply about almost any of the answers which we glibly give to children, we would recognize that we don't really have a satisfactory answer to most of their questions. Many of our answers are no more than a repetition of what we as children heard from adults. We pass on the misconceptions of our parents and those of their parents. We say what we heard, not what we know. We rarely join the quest with our children. We rarely admit our ignorance, even to ourselves. Why does rain fall from the sky? Why is snow cold? What is electricity and how does it go through the wire? Why are people bad? Why does evil exist? Why is there war? Why did my dog have to die? Why do flowers bloom? Do we really have good answers to these questions?

Question: How does curiosity fit in with critical thinking?

Paul: To flourish, curiosity must evolve into disciplined inquiry and reflection. Left to itself, it will soar like a kite without a tail, that is, right into the ground! Intellectual curiosity is an important trait of mind, but it requires a family of other traits to fulfill it. It requires intellectual humility, intellectual courage, intellectual integrity, intellectual perseverance, and faith in reason. After all, intellectual curiosity is not a thing in itself, valuable in itself and for itself. It is valuable because it can lead to knowledge, understanding, and insight, because it can help broaden, deepen, sharpen our minds, making us better, more humane, more richly endowed persons.

To reach these ends, the mind must be more than curious, it must be willing to work, willing to suffer through confusion

and frustration, willing to face limitations and overcome obstacles, open to the views of others, and willing to entertain ideas that many people find threatening. That is, there is no point in our trying to model and encourage curiosity, if we are not willing to foster an environment in which the minds of our students can learn the value and pain of hard intellectual work. We do our students a disservice if we imply that all we need is unbridled curiosity, that with it alone knowledge comes to us with blissful ease in an atmosphere of fun, fun, fun. What good is curiosity if we don't know what to do next, how to satisfy it? We can create the environment necessary to the discipline, power, joy, and work of critical thinking only by modelling it before and with our students. They must see our minds at work. Our minds must stimulate theirs with questions and yet further question, questions that probe information and experience, questions that call for reasons and evidence, questions that lead students to examine interpretations and conclusions, pursuing their basis in fact and experience, questions that lead students to discover their assumptions, questions that stimulate students to follow out the implications of their thought, to test their ideas, to take their ideas apart, to challenge their ideas, to take their ideas seriously. It is in the totality of this intellectually rigorous atmosphere that natural curiosity thrives.

Question: It is important for our students to be productive members of the work-force. How can schools better prepare students to meet these challenges?

Paul: The fundamental characteristic of the world students now enter is ever-accelerating change, a world in which information is multiplying even as it is swiftly becoming obsolete and out of date, a world in which ideas are continually restructured, retested, and rethought, where one cannot survive with simply one way of thinking, where one must continually adapt one's thinking to the thinking of others, where one must respect the need for accuracy and precision and meticulousness, a world in which job skills must continually be upgraded and perfected, even transformed. We have never had to face such a world before. Education has never before had to prepare students for such dynamic flux, unpredictability, and complexity, for such ferment, tumult, and disarray.

We can create the environment necessary to the discipline, power, joy, and work of critical thinking only by modelling it before and with our students. They must see our minds at work.

Assessment of the future must focus on higher, not lower, order thinking, that it must assess more reasoning than recall, that it must assess authentic performances, students engaged in bona fide intellectual work.

We as educators are now on the firing line.

- Are we willing to fundamentally rethink our methods of teaching?
- Are we ready for the 21st Century?
- Are we willing to learn new concepts and ideas?
- Are we willing to learn a new sense of discipline as we teach it to our students?
- Are we willing to bring new rigor to our own thinking in order to help our students bring that same rigor to theirs?
- Are we willing, in short, to become critical thinkers so that we might be an example of what our students must internalize and become?

These are profound challenges to the profession. They call upon us to do what no previous generation of teachers was ever called upon to do. Those of us willing to pay the price will yet have to teach side by side with teachers unwilling to pay the price. This will make our job even more difficult, but not less exciting, not less important, not less rewarding. Critical thinking is the heart of well-conceived educational reform and restructuring because it is at the heart of the changes of the 21st Century. Let us hope that enough of us will have the fortitude and vision to grasp this reality and transform our lives and our schools accordingly.

Question: National Standards will result in national accountability. What is your vision for the future?

Paul: Most of the national assessment we have done thus far is based on lower-order learning and thinking. It has focused on what might be called surface knowledge. It has rewarded the kind of thinking that lends itself to multiple choice machine-graded assessment. We now recognize that the assessment of the future must focus on higher, not lower, order thinking, that it must assess more reasoning than recall, that it must assess authentic performances, students engaged in bona fide intellectual work.

Our problem is in designing and implementing such assessment. In November of this last year, Gerald Nosich and I developed and presented, at the request of the U.S. Department of Education, a model for the national assessment of higher order thinking. At a follow-up meeting of critical thinking, problem-solving, communication, and

testing scholars and practitioners, it was almost unanimously agreed that it is possible to assess higher-order thinking on a national scale. It was clear from the commitments of the Departments of Education, Labor, and Commerce that such an assessment is in the cards.

The fact is we must have standards and assessment strategies for higher-order thinking for a number of reasons.

- First, assessment and accountability are here to stay. The public will not accept less.
- Second, what is not assessed is not, on the whole, taught.
- Third, what is mis-assessed is mis-taught.
- Fourth, higher-order thinking, critical thinking abilities, are increasingly crucial to success in every domain of personal and professional life.
- Fifth, critical thinking research is making the cultivation and assessment of higher-order thinking do-able. ■

Higher-order thinking, critical thinking abilities, are increasingly crucial to success in every domain of personal and professional life.

his article was first printed in ASCD Review, Mar 1996

Rethinking Leadership -Tentative steps to becoming a Thinking School.

Karen Oei

Reading Peter M. Senge's book ***THE FIFTH DISCIPLINE (1990)*** has been an uplifting experience. In it, Senge expounded key characteristics of the "Learning Organisation" which basically promotes systems thinking and the respect for more complete learning at different levels of knowing in teams. Here, at last, is a book that helps leaders to address deeply and simply men's organisational woes for survival in a secular age of dramatic changes. Senge's 'Learning Organisation' approaches talk about how companies could function or malfunction in an era of high transient technologies, high information over-flows and vast interconnectedness of the world. It also warns of the imminent collapses of fixated, rigidly controlled Tayloristic organisations with problems of coping and satisfying human growth and the renewal of organisations through lack of re-development of staff for meaningful work and competitive worthwhile services. In the new century, individuals have to learn to value continuous, life-long learning and team-learning to maximise an organisation's potential. Leaders must come to terms with changed management styles that accommodate the dawning of the knowledge-based economy, an age of self-empowerment of the knowledge-efficacious employees. Leaders will not be able to put a cap on authentic communication between peoples in organisation and around the world. This would mean they have to cope with well-informed subordinates who collectively are out-learning them or are better at contributing to the well-being of their organisations than they. In such a context of post-modern tendencies, people will co-shape their work environments with wide human understanding of the different worlds in a new millennium of expansive information and new meaning for work and life.

In the new century, individuals have to learn to value continuous, life-long learning and team-learning to maximise an organisation's potential.

For the Singapore school leaders, many could well be daunted by these changes. Not having been updated on the changes in human learning, leaders now need to wake up from their busy schedules to the radically different hermeneutics movement sweeping the world of extensive learning and expansive connected meanings in understanding. New global operations

will affect the management functions of organisations in a shrinking world of many specialised needs. What could constitute 'facts and truths' are now mere personal preferences, bigotry and gross assumptions. The passing of positivist thinking to the post modern makes changes in the approaches to education compelling. These to be in response to managing well the 3rd Wave knowledge-based economy hitting our world.

The re-orientation of education for new learning perspectives in the modern and post-modern thinking and understanding (Lincoln, Y.S. & Guba, E.G. 1985) should therefore receive great attention. The TSLN School will have to draw quickly on many areas of knowledge, threads of thinking and ways of knowing to help students grasp how others function and how they should learn.

If we are to lead future schools, we need to be conversant about the world of different meanings and ways of knowing (E. Eisner's, 1985). Learning only in the traditional linear sequential thinking mode has seen its days as it limits learners' intuitive, holistic and creative thinking in the IT enhanced era. Increasingly, old knowledge and attitudes have failed to hold the solid middle ground for groups in developed societies. In the light of what man now knows about his world, whole brain functions, cognitive sciences, mental flows in creative thinking, intuitive inductive-deductive thinking etc., (Czikszentmihalyi, M. 1996) have all added to the support of new pedagogical approaches in teaching and learning. What is customised is the holistic education of our students and how to build their collective consciousness and awareness of our world will challenge the way we educate our people for life in the future.

Learning only in the traditional linear sequential thinking mode has seen its days as it limits learners' intuitive, holistic and creative thinking in the IT enhanced era.

Consciously or unconsciously, education leaders have till recently been over dogmatic about our educational know-how, behaving as demi-gods of know all, dictating and forcing our limited world views on subordinates, and hammering them into positions of deference and subservience to work as we deem fit. As mindful as some were to guard their hierarchical status and political structures, we all now have to help flatten hierarchy and 'hang loose' for a more realistic way of relating to others in work. Leaders must link to able co-workers and see the adult workplace through the eyes of other adults. In school, educators should not, because of their position and their own shortfalls in learning and understanding, inadvertently demean their multi-facetted fellow workers through straight jacketing educational functions. This would leave to fallow diverse student talents and staff ability, failing to recognise the creative and innovative individuals. Working

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largely to what was traditionally believed and understood to be 'successful and respectful' education, we fail to respond to phenomenal changes in New World thinking and learning.

Interestingly, now that leaders are free to shift somewhat from their earlier positions and mindsets, from the determinist positivist mode to more of the shared inquiry modus operandi in school, the question of competency in the post-modernistic mode are getting in the way of reconstructing the realities. Leaders have to adapt to the post-modern language and understanding and acquire new sensitive qualitative knowledge forms. As exemplified in the Senior Minister Lee Kuan Yew's recent book, aptly named ***THE SINGAPORE STORY (1998),*** quite evidently he too has tuned into the awareness of post-modern language stance. He has acknowledged that his book is a personal story, seen from the perspectives and experiences of a man who reconstructed it. So too, our education leaders must tussel with the new unfamiliar stance and be sensitive to post-modern language, understanding its place in the education of our children. We need to move to a new definition of our Education story, and learn how to "re-story" our educational context for the immediate future.

As school leaders, some of us have made tentative starts at fostering the TSLN culture in our schools, seeking to re-culture learning with some degree of trepidation and impunity. It is evident that individual schools achieve real changes in learning in varying ways even with our limited understanding of all the new perspectives in education. With the nation's leaders well enlightened to signal these changes and to stake a clear commitment to co-opt people's ideas at all levels, more should happen very quickly. Sharing Senge's learning perspectives, we have integrated learning in various knowledge areas in the school (e.g. Thinking skills, IT skills, National Education, pragmatic considerations of economics and policy, as well as the existence of multiple-levels of personal and inter-personal interests and needs) and these have helped coalesce the context for thinking and understanding for all. We seek to deliver an authentic and systemic interpretation of our environment to develop a vibrant learning organisation in response to national needs. Shaping patterns of thinking in teachers and students, fostering creative responses to personal and civic problem solving, and doing things well together can be tremendous in moving the collective consciousness and achievement of goals for everyone in school. To attain the Desired Outcomes in Education, the leader's persistent observation for opportunities to network more patterns

of thoughts, choices and characteristics of a learning organisation will prove useful.

In tandem with the new approaches to managing schools'change, we have also reigned in the simpler works of educators who lead, share and embrace the ***foundational beliefs*** of the Fifth Discipline. Dr. Edward Deming's ***TOTAL QUALITY MANAGEMENT*** is one such early work adopted. TQM is developed along the Theory of Profound Knowledge that included the elements of the psychology of human behaviour, the appreciation for variation, the understanding of systems and the theory of learning. Much of this work contrasted the old paradigm with the new shifts in education and the work ethics characteristic of the old with the demands of the new. Demings' ideas for application are user friendly, bridging some old ways of doing things yet accommodating the new. Similarly, Dr, Robert J. Garmston's ***FIVE- PASSIONS OF PEAK PERFORMERS*** discusses the holonomous states of minds of those who can work autonomously and interdependently. The five states of mind help explore learners' states of efficacy, flexibility, consciousness, interdependence and craftsmanship, and many of these elements share the beliefs in Senge's understanding of organisation disciplines. All the strategies are invaluable in themselves to help leaders promote the TSLN culture.

It is reassuring to note that Senge would not advocate the use of his book as new gospel. His disciplines are, after all, a distillation of the many years of work of other noted MIT systems engineers such as Jay Forrester (systems dynamics), David Bohm (team learning), Chris Argyris (mental models) and Chalie Kieffer (personal mastery). He would prefer that organisations do what they deem fit to promote thinking and systems understanding. Senge advocates in particular the formation of small groups where visions could be better shared through meaning-loaded dialogues in honoured small group conversations. In small groups, ideas and thoughts are better conveyed and understood over time. Transforming sensed feelings and putting the group's collective thinking to work in knowledge-rich dialogical committees similarly ensures greater creativity and innovation. Small group committees as in WITS are more efficacious. Schools should have no difficulty starting small communities where colleagues could have conversations about their educational problems, concerns, dreams and aspirations for their school. These groupings are better able to have their thoughts supported, aligned and their mental models harmonised to structure a context for extraordinary action, creative work and innovation.

Transforming sensed feelings and putting the group's collective thinking to work in knowledge-rich dialogical committees similarly ensures greater creativity and innovation.

Training of our staff should be more inter-disciplinary, integrated in areas of learning to transcend the artificial compartmentalisation of insights and knowledge.

In alignment with a Thinking –Learning Organisation, continuous learning is important. There is a need to shift staff training and development towards extensive and borderless learning which requires moves towards a culture of personal mastery, of collaborative work for genuine team learning, of understanding systemic thinking and shared vision in the organisation for TSLN schools. Training of our staff should be more inter-disciplinary, integrated in areas of learning to transcend the artificial compartmentalisation of insights and knowledge. The professional growth of groups' members should thus be more extensive, with their 'infoscapes' and 'technoscapes' more interestingly intertwined. Levels of learning should scaffold to increase staff and student competencies. The corporate culture should match the depths of each member's intellectual, social and spiritual requirements, transforming the visioning of all corporate members to attainable and desirable goals.

In any organisation, glitches against the TSLN culture should always be recognised and nipped quickly if insidious. Verily, if members seek to safeguard their jobs and career benefit first with deference only to those in hierarchy, challenging the status quo with new knowledge for improvement is unlikely. If individuals in the group are hasty to mouth slogans but slow to act on sound intuitive thinking and information at the front line, a quality school is unlikely to emerge. Preferring to assume the postures of wait-and-see, not rocking the boat, but pre-judge the motives of others, or to ingratiate for any advantage at all fronts to avoid uncomfortable action will somehow compromise the goals of TSLN schools. For a safer stance to wait-on rank and structure, if people were too afraid to act on their natural impulses for the good of the organisation, much is lost with no bottom-up efforts sustainable and creativity fostered.

Senge related that E. Deming, the creator of the Total Quality Management now in his 90's, is increasingly pessimistic about his country (the USA) that they have not turned the corner in the meaningful education of his people. We in Singapore should do better, as we do not have the luxury of dragging our feet in the new economy. 'Just in time' management could have been 'done in good time' if we could be a little more forward thinking, responsive and learning well for a better tomorrow. ■

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Mrs Karen Oei *is the Principal of Bendemeer Secondary School*

Creating Schools for Thought

Teresa Secules, Carolyn Cottom, Melinda Bray and Linda Miller

We want to know if that's the right place for the eagles to live, but we think it is. "We want to know how high the tower is — cause if they fall, they might kill themselves when they're a baby eaglet."

"We need to know if the tower prefabs are warm enough for the baby eagles to hatch."

Students in Kerry Sinclair's 5th grade Schools for Thought classroom are weighing the advantages and disadvantages of using various hacking towers[1] to release young eagles into the wild. Working in groups, these students at Carter Lawrence Middle School in Nashville, Tennessee, will draft plans to save the threatened bald eagle. They must research the biology, behaviour, and habitat of the species, as well as causes of their endangerment. This task mirrors similar work on recovery plans by conservationists; as a result of this work, the bald eagle is no longer listed as an endangered species.

Students search through CD-ROMs, books, articles, and the Internet for information on food, nesting, and current recovery plans. Using computers, they write, edit, revise, and publish group reports. In an interactive computer forum specially designed for classrooms, they continually discuss the underlying issues, building on one another's findings. They move from concerns of saving the national symbol of the United States to realizing that even flies are necessary to the food chain.

These students became interested in saving the species while planning a simulated rescue of a wounded bald eagle. A video adventure, *Rescue at Boone's Meadow*, had challenged them to figure out the fastest way to get the eagle to the veterinarian from a remote meadow. To answer the challenge, students had to make decisions based on their calculations of rate, time, distance, weight, and miles per gallon of gasoline. Because the mathematics is set in real life, students also faced broader considerations, such as the safety of the human rescuers and costs versus benefits of saving one eagle.

Students engage in creative inquiry, and teachers facilitate their learning in the technology-rich environment of classrooms participating in the Schools for Thought program.

In each project, Schools for Thought students acquire, evaluate, organize, and interpret information, then communicate their findings to their peers and to an authentic audience of adults. Audience members ask questions to help the students learn even more. The teacher creates a climate of inquiry that fosters learning with understanding, rather than simply memorizing facts.

Creating a Model for Learning

Schools for Thought evolved from three programs developed by independent groups of university researchers in collaboration with classroom teachers (see page 25):

- The *Jasper Woodbury* mathematical problem-solving series,. a videodisc-based program developed at Vanderbilt University (Cognition and Technology Group at Vanderbilt 1997).

- *Fostering Communities of Learners* for teaching science and literacy, developed at the University of California at Berkeley (Brown and Campione 1994).

- *Computer-Supported Intentional Learning Environments* (CSILE), a communal database that supports information sharing and knowledge building, developed at the Ontario Institute for Studies in Education (Scar-damalia et al. 1994).

Before being integrated into Schools for Thought, each program was classroom tested and each showed clear benefits for students — including higher rates of achievement (Lamon et al. 1996).

In 1993, the three groups of researchers combined their programs in an effort to restructure middle school classrooms. They named the project Schools for Thought after John Bruer's book (1993). In Nashville, the Cognition and Technology Group at Vanderbilt initiated a pilot project in two inner-city, 6th grade classrooms. The project has now grown to 22 classrooms. Schools for Thought classrooms are under development across the continent, from California to Iowa to Ontario.[2] The most notable site is Compton Drew Investigative Learning Center in St. Louis, where an entire magnet school with this philosophy has opened.

In 1996, Metropolitan Nashville Public Schools and Vanderbilt researchers expanded Schools for Thought into 1st grade classrooms, using the award-winning multimedia Little Planet Literacy Series.

The deliberate combination of specialization and sharing facilitates both depth and breadth in students' learning.

The questions that arise in the students' inquiry require them to use basic skills, creative thinking, communication, and teamwork.

The Learning Community

Schools for Thought recognizes that learners actively construct their own knowledge rather than passively receiving it from the teacher. They work in collaborative groups, using technology frequently. Teachers, students, and researchers are engaged in continuous learning about learning, based on principles that include the following:

The curriculum is rigorous and standards-based. Students choose their own research topics within a framework set by their teachers to facilitate understanding of important, consistent principles in the core content areas. For example, while studying habitats and endangered species, 6th graders learn about the rise and fall of ancient civilizations — studying cycles, adaptation, and change in both science and social studies — and about sampling and prediction, the mathematics scientists use in determining whether a species is endangered. At the same time, while reading the novel *Hatchet*, students explore issues of human survival and adaptation to adverse circumstances. The questions that arise in their inquiry require them to use basic skills, creative thinking, communication, and teamwork.

Students work together in groups for specific purposes. Several group structures — research groups, reciprocal teaching (Palincsar and Brown 1986), and cooperative learning "jigsaw" groups — are systematically integrated into the curriculum model (Brown and Campione 1996). For example, students in Sinclair's classroom generated questions on information needed to save the endangered bald eagle. Each group studied one aspect of the dilemma, using reciprocal teaching groups to read difficult materials and CSILE to explore issues. Then they shared their findings in jigsaw groups with students who had studied other aspects of the problem. Finally, the jigsaw groups created recovery plans for specific geographic areas, which required that each group member learn about all the other groups' research. Students cannot create this end product of their research — called the consequential task — without learning what other students and groups have studied. This deliberate combination of *specialization* and *sharing* facilitates both depth and breadth in students' learning.

The careful integration of process and content promotes creation of a true learning community. Many children in these classrooms state that learning how to collaborate is one of their greatest accomplishments. A visitor from the local chamber of commerce was impressed:

"They had to learn how to work together and how to listen. You could actually watch children listening to each other, thinking about what the other child said and incorporating that, then offering the next thought."

Feedback on student learning comes from many sources. Students share information with other students as much to find out what they still need to learn as to inform others. Students know they are individually accountable and prepare for presentations and tests, often helping one another.

Teachers actively monitor student thinking. Teachers browse the student-created database and talk with research groups. Removal from the "sage on the stage" role gives teachers time to listen to individuals and groups of students, ask well-placed questions, provide information "just in time," or suggest resources.

Everyone is a part of the learning community. This community includes students, teachers, administrators, parents, business leaders, and members of the surrounding community. Students create and share authentic products, such as books and multimedia presentations. Corporate volunteers serve as authentic audiences for classroom presentations, experts in a specific topic or skill, mentors, and facilitators in problem-solving and team building.[3]

Students use technology in authentic ways. Technology does not simply provide a modern format for practicing basic skills, as it does in many classrooms. Students use technology to gather information not found in their school libraries, and they write research reports. They create multimedia supports for oral presentations of their work, and they discuss their findings with other researchers in their classrooms and across the country.

Assessing the Impact of Schools for Thought

During the 1994-95 school year, researchers at Vanderbilt compared student achievement in Nashville's 6th grade Schools for Thought classrooms to those not using the approach. We examined performance on the Tennessee state-mandated standardized achievement test, on the Tennessee Comprehensive Assessment Program (TCAP), and on complex performance assessments of reading and writing. The performance assessments measured students' skill in reading to evaluate an advertisement and in writing for clarity of communication.

Removal from the "sage on the stage" role gives teachers time to listen to individuals and groups of students, ask well-placed questions, provide information "just in time," or suggest resources.

We have learned that excitement about learning is contagious — an important factor in making massive changes in teaching and learning.

Analysis of the 10 subtests of the TCAP revealed that our students scored as well as, or significantly better than, the comparison classes on all of the subtests. Our students' scores for reading comprehension, overall reading skills, social studies, science, and study skills were significantly higher than the scores of comparison classes.

The complex performance assessments required students to use high-level critical thinking skills in reading and writing, competencies not tested by TCAP. Students wrote an essay on "If you could change something about your world, what would you change? Why? How?" They read and summarized a multi-paragraph advertisement from the local newspaper, defined words in context, generated research questions to decide whether the claims were legitimate, and evaluated potential sources of information for their relevance.

On both performance assessments, Schools for Thought students scored significantly higher than did students in the comparison classrooms. Not only were our students doing as well or better than the other students on standardized achievement tests, but they were also acquiring critical thinking and problem-solving skills that the other students were not.

Preliminary assessment of the social impact of Schools for Thought, by Helen Bateman,[4] used students' self-reports about safety, social skills, classroom behaviour, and sense of community; students' problem-solving responses to stories about conflict; and school discipline records. Our students responded more positively on all items of the self-reports, created more win-win solutions to the conflict stories, and had fewer suspensions.

Excitement About Learning

We have learned that excitement about learning is contagious — an important factor in making massive changes in teaching and learning. Excited parents have been vital in spreading Schools for Thought to other schools in Nashville. During the pilot year, parents asked the superintendent to expand the program to the next grade so their children could continue with it.

Parents expressed surprise at the change in their children's attitudes toward school. At the dinner table, children talked about endangered species and Egypt. Two classes of students took their excitement about learning to new heights: To complete a book they were writing, they stayed two hours after school every

day during the last week of school. Parents see their children transfer what they learn in class to other aspects of their lives. One student who had never spoken in public before chose a Boy Scout badge that required him to make a presentation.

Teachers excited about learning serve as important "living models" for their students. Their attitudes infect the students, underscoring Barth's (1990) claim that when teachers "engage in serious learning themselves, their students take learning more seriously" (p.46). Also, when teachers collaborate with researchers, they model — for other teachers — the process that students are using in Schools for Thought classrooms (Bray 1996).

We continue to develop Schools for Thought. It is not a package, not a final product — it depends on continuous improvement in creating a learning community. The most important lesson we have all learned is that when teachers, students, and researchers collaborate to focus together on learning, everyone benefits. ■

[1]A hacking tower simulates the environment of a nest to encourage reintroduced eaglets to return to the area when they reach maturity.

[2]Collaborations in California, St. Louis, Toronto, and Iowa were funded by the J.S. McDonnell Foundation.

[3]First American National Bank supports corporate volunteers in Schools for Thought classrooms and broader initiatives to develop learning communities in Nashville.

[4]Preliminary data are available on the World Wide Web at http://peabody.vanderbilt.edu/projects/funded/sft/general/sfthome.html.

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The most important lesson we have all learned is that when teachers, students, and researchers collaborate to focus together on learning, everyone benefits.

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***Teresa Secules** is Curriculum and Assessment Coordinator, **Carolyn Cottom** is Community Coordinator, **Melinda Bray** is Research Associate, and **Linda Miller** is Professional Development Coordinator of the Schools for Thought Project at Vanderbilt University, Nashville, Tennessee.*

Other members of the Schools for Thought Learning Collaborative — including teachers, administrators, and researchers — are listed on the Internet at http://peabody.vanderbilt.edu/projects/funded/sft/general/sfthome/htl. Address correspondence to Carolyn Cottom, Learning Technology Center, Vanderbilt University, Box 45, Peabody College, Nashville, TN 37203 (e-mail: COTTOMCD@ctrvax.Vanderbilt.Edu).

Educational Components of Schools for Thought

Animation, interaction, and involvement are the hallmarks of the Schools for Thought Project. Students construct their own meaning in many subject areas as they interact with video, trade books, CD-ROMs, problem-solving models of instruction, computer databases, multimedia programs—*and one another.* Whether researching endangered species, serving in the community, or building their own books, students learn through projects related to real concerns. The following programs are components of Schools for Thought.

- The *Jasper Woodbury Program* teaches mathematical problem solving through video dramas. Students must solve complex, realistic problems by setting goals, devising strategies, finding relevant information in the video, figuring out what mathematics to use, and then doing the math. Mathematics becomes an object of discussion and a practical link to the community. For example, in *Blueprint for Success*, students use geometry to design a neighbourhood playground; in *A Capital Idea*, students use statistics and probability to design a recycling project to raise money for a Washington, D.C., trip.

  Jasper is distributed by Learning Inc., 10 Industrial Ave., Mahweh, NJ 07430-2262. Internet: http://peabody.vanderbilt.edu/projects/funded/jasper/Jasperhome.html

- *Fostering Communities of Learners* engages students as researchers of important issues in fields such as biology and ecology. For example, students study why and how diseases like tuberculosis and AIDS spread. Groups of students work on different but interrelated parts of the problem, building expertise and sharing their learning during the research process. This *distributed expertise* model establishes a purpose for communicating with peers, as well as interdependence among students and teachers.

- Using *Computer-Supported Intentional Learning Environments* (CSILE), students build a communal knowledge base, just as scientists use conferences and newsgroups to discuss their ideas. For example, students researching photosynthesis, medieval history, 18th century literature, or Cubism can use CSILE to elaborate their own ideas online. They can provide feedback to others; analyze text and graphics material; build graphic models; and link ideas across units and classrooms, communities, and even continents. Schools for Thought will soon combine databases of working scientists, curators in art galleries, the business community, and educational institutions.

  CSILE is distributed by Learning in Motion, 500 Seabright Ave., Suite 105, Santa Cruz, CA 95062-3481; (1-800) 560-5670; http://CSILE.OISE.utoronto.ca (see also Educational Leadership, November 1996, pp. 6-10).

- The *Little Planet Literacy Series*, a multimedia program for beginning readers, evolved from Jasper and Schools for Thought. Animated video stories create a world where children love to read and write. These stories "anchor" student activities, such as sequencing, decoding words, and writing and recording their own books. A related math and science curriculum is being developed through a grant from the McDonnell Foundation.

For further information, contact Little Planet Publishing, P.O. Box 158427, Nashville, TN 37215-8427; (1-800) 974-2248; http://www.littleplanet.com/.

A forthcoming (fall 1997) multi-media book by the Schools for Thought collaborative will introduce educators to Schools for Thought. For publication information, contact Pio Po'e, Learning Technology Center, Box 455, Peabody College, Vanderbilt University, Nashville, TN 37203

Kids Ask The Best Questions

Debby Deal and Donna Sterling

- Why is it cold in winter?
- What happens if you leave the salt out of the chocolate cookie recipe?
- How do giant cruise ships stay afloat?
- Do fish prefer real worms or fake ones?

In science class, students always seem to have more questions than teachers can answer. Before answering any more questions, perhaps we should pause and ask ourselves if we *should* answer them. The *National Science Education Standards* (National Research Council 1995) recommends that instead of imparting knowledge, our role is to help students develop the skills, values, and attitudes that facilitate a scientific understanding of the natural world. "Inquiry into authentic questions generated from student experiences is the central strategy for teaching science," the *Standards* states.

The first questions teachers may have are (1) How do we involve students in asking questions? and (2) What do we do after they ask them?

The idea that questioning strategies are a key attribute of inquiry-based teaching (Rowe 1978) is not new. But historically, either the teacher initiated the questions, or the teacher or students recited them from a textbook. In either case, the student's job was to provide the "right" answers. Fortunately, educators have begun to think of teachers and students as members of a community of learners (Moll and Whit-more 1993). As such, the class learns through a balance of teacher and student questions.

The Soap Question: Balancing Teacher-Directed Inquiry

Effective classroom questions promote relevance, encourage ownership, help students interpret their observations, and link new learning to what students already know.

In our middle school classes, we have discovered that students ask questions that often directly relate to the goals and objectives we have established. By integrating their questions with the

By allowing students to generate questions and explore and interpret what they see, we can stimulate their appetite for explanation as they experience the thrill of scientific discovery.

activities we have planned, we can reinforce learning in the limited time we have. For example, during a unit on density, students' questions helped us make the transition from teacher-directed to student-directed learning. Together, we dispelled many misconceptions about this concept (such as that heavy things sink).

Before planning the unit, we wanted to find out what students already knew and what they were interested in learning. We enlisted Ogle's (1986) teaching strategy, whereby students connect their prior knowledge with new learning within an organized framework — a "K-W-L" chart (Know–Want to Know–Learned).

One student asked, "Why does Ivory® soap float and other soaps sink?" The question initiated a class discussion, during which other students acknowledged that they, too, had wondered about this. Students suggested a range of explanations — Ivory is lighter, Ivory has more air, coloured soaps are heavier because they have more dye, and "It must have something to do with what the soap is made from." The soap question, which students related to their real-world experience, was a perfect extension to the investigations we were considering. As a class, we began filling out a K–W–L chart on sinking and floating.

For example, during a unit on density, students' questions helped us make the transition from teacher-directed to student-directed learning. One student asked, "Why does Ivory soap float and other soaps sink?"

The Density Question: Building a Conceptual Foundation

We decided to help students construct a conceptual foundation about density and then use the soap question to reinforce and extend the concept. Students began by investigating how a variety of common objects, such as balloons, plastic utensils, rubberbands, and crayons, act in water.

As cooperative groups, students determined the mass and volume of each object and identified the relationship between the two. We then introduced the equation $d=m/V$ (density equals mass divided by volume), enabling the students to use their data to determine whether each object was a sinker or a floater. Throughout this activity, we asked a variety of questions to help students interpret their observations and data. We had planned our questioning strategies in advance to make sure we asked a range of high- and low-level questions. We began with attention-focusing questions (Elstgeest 1985) to help students develop a knowledge base. This would enable the students to apply what they learned through low-level questions to answering higher-level questions. We then asked them to consider both qualitative

They also appeared to have developed a great deal of ownership of the soap question and were highly motivated to come up with the right explanation.

and quantitative observations to help them respond to comparison questions and order their data.

Sinkers or Floaters? Applying What's Learned

Our next set of questions was designed to get the students to apply what they had learned about density by hypothesizing what would happen in related situations. After asking them to describe each object, we asked them questions such as:

- Which objects were sinkers? Floaters?
- Which objects have greater mass than volume?
- Look at all the sinkers. What can you tell me about the relationship of mass to volume?
- How are all the floaters alike? How are all the sinkers alike?
- What do you now know about objects that sink? Float?
- What do you think will happen to the results if more mass is added to each object? How do you know? How can you find out?

At our next hands-on session, we returned to the K–W–L chart and revisited the soap question. This time, we asked, "Using what we have learned about density, what explanations can you now offer?" Some students immediately applied what they had learned, responding that the mass of the bar of Ivory was less than its volume. Others said the density of the bar of Ivory soap must be less than one, and some students were not yet ready to offer an explanation. Accordingly, our next question was, "How can we find out?" This laid the groundwork for students to take an active role in planning the investigation process.

How Can We Find Out? Investigating

The class broke into small groups, each of which discussed the question and proposed a plan. We then reassembled to consider each group's plan and select one to implement. (Alternatively, each group could have tried its own plan and then compared results.)

The procedures were similar to those we modelled in the earlier lab, except this time students were more attentive to details. Apparently, they had discovered that a slight irregularity in measurement could skew the results. They also appeared to have developed a great deal of ownership of the soap question and were highly motivated to come up with the right explanation.

The students wanted to test as many brands of soap as possible and they brought in more than we needed. Before proceeding, each student wrote a hypothesis and set up a data table. During the investigation, we observed students at work and asked spontaneous questions, such as: "What do you notice about the float line?" and "How does bar *X* compare to bar *Y*?"

Why Do the Grapes Sink? Generalizing Learning

When the lab ended, we again used a hierarchy of questions to help students make sense of their data. This time we wanted to find out whether the results of their investigation supported their conclusions from the first lab and how well they could apply the idea of density to new situations. We asked them to use words and pictures to respond to two questions:

1 As you use a bar of soap, how does this affect its density?
2 You are canoeing on the river and your canoe tips over. The grapes and a film can with film in it sink, but the apple and an empty file can remain afloat. How do you explain this? (For this question, we displayed a tank with the four items.)

Student responses helped us assess what they learned so we could decide how to proceed.

Unlike the Ivory soap question, not all questions students ask are appropriate for hands-on classroom investigations. For example, while brain-storming what they wanted to find out about sinking and floating, some students asked interesting, research-oriented questions, such as, "Why does ice float?" "Why do dead fish float?" and "Will lead float?"

If we are to emphasize hands-on/minds-on learning, we must recognize that research is a valid and critical aspect of scientific inquiry. Observations, rather that laying to rest a question, may promote related questions that cannot be answered through sensory experiences alone (Matthews 1992). Students need to gain familiarity with accepted research that has gone through the validation process (National Research Council 1995). For this reason, we help our middle school students acquire the skills necessary to pursue their research questions.

If we are to emphasize hands-on/ minds-on learning, we must recognize that research is a valid and critical aspect of scientific inquiry.

Why Do Dead Fish Float? Minilessons and Research

To teach research skills, we use the minilesson — an approach we borrowed from Calkins and Nancie Atwell (Atwell 1987). Our

Our goal is for students to be able to sort their questions into two groups: those we can safely investigate in the classroom with readily available materials and those that require research as a primary approach because of safety requirements and materials needed.

first minilesson usually focuses on classifying and clarifying student questions.

Our goal is for students to be able to sort their questions into two groups: those we can safely investigate in the classroom with readily available materials and those that require research as a primary approach because of safety requirements and materials needed. If the class does not reach a consensus on a question, we facilitate a peer debate and let the students attempt to convince one another.

Once students determine which questions have a research focus, we lead a set of minilessons that address the question, "How can you find out?" Through examples, we discuss how to select the resources that are most appropriate for a particular task.

For example, when we asked students how they would begin to research the question, "Why do dead fish float?" they began with experts. They said they could ask a science teacher or someone who works at a fish store, although they might learn more from an ichthyologist. Of course, we then explored how to find an ichthyologist. We also introduced them to a variety of other resources, including trade books, encyclopedias, almanacs, the Internet, and videotapes.

With limited class time, it is difficult to have all students address all the questions. We have learned that a more practical approach is to ask each group to become an expert on one question. Or two or more groups may research the same question and then compare their resources and results. This again reinforces the idea of establishing validity.

I Was Surprised to Learn That: Holding a Miniconference

Next, as a class, we plan a miniresearch conference. Members of each group present their research and students ask other groups specific questions. We sometimes formalize the questioning procedure. We may distribute index cards before the conference and ask each student to write a follow-up question for another group. After each presentation, the student-researchers collect and respond to the questions.

Another strategy is to have students fold a sheet of paper into four sections and respond to the presentation by writing down questions they still have and information they appreciated learning about. They then hand over their responses to the presenters.

For example, the responses might begin with the phrases "I was surprised to learn . . . ," "I liked the way . . .," "This picture represents . . .," and "Questions I still have . . ."

This process of investigating research questions and sharing data allows us to learn about a variety of questions in a limited amount of time. It also reinforces the idea that we are a community of learners.

Even with creative approaches, we will never teach all there is to know about science. But as partners in the learning process, we can help students acquire the scientific skills and habits of mind that lead to understanding (Rutherford and Ahlgren 1990). We can also stimulate their appetite for explanation and encourage their sense of wonder. ■

But as partners in the learning process, we can help students acquire the scientific skills and habits of mind that lead to understanding

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***Debby Deal** is a doctoral student and Adjunct Professor of Education at George Mason University. She can be reached at 13155 Compton Rd., Clifton, VA 21024.*

***Donna Sterling** is in the Graduate School of Education, George Mason University, Fairfax, VA 22030.*

"Education on the Edge of Possibility"

Chan Poh Meng

Below is a book review on the book "Education on the Edge of Possibility" by Renate Nummela Caine and Geoffrey Caine (1997) ASCD.

Caine and Caine hope to "lend direction and vision" to educators caught in the flux of changes. As a kind of follow-up to "Making Connections : Teaching and the Human Brain", their previous book published in 1991 which expounded on brain research, this book focused on how the theory of brain-based learning was actually implemented in two schools (Dry Creek Elementary School and Park View Middle School) in the United States. Readers eager for strategies, techniques or methods may ultimately be disappointed (not because there are no practical ideas; in fact the book is filled with numerous suggested worksheets and exercises) for the authors concluded that the emergence of a higher-level learning organisation is not dependent on prescriptive processes and theories but the workings. And because these workings occur at the deep recesses of the mind/brain, thinking unique to the individual can only be influenced. Exploration of the power of thinking and how it determines mental models about teaching and learning is what this book is about.

. . . the emergence of a higher-level learning organisation is not dependent on prescriptive processes and theories but the workings . . . at the deep recesses of the mind/ brain, thinking unique to the individual. . .

Eight current patterns of thoughts about teaching and learning that have emerged and created multiple tensions in education as identified by Caine and Caine are:

- Our collective pictures and visions don't match
- People hold fundamentally different views about who "owns" information and about how it reaches children.
- With all the action and calls for reform, schools and the education system are notoriously resistant to change.
- Even though the education system appears to resist change, it is enmeshed in an unprecedented degree of turmoil and turbulence.

- A jumble and clash of overlapping questions and issues all seem to run into each other.
- Concerns about a teacher's role in using technology in classrooms have yet to be resolved.
- There is enormous teacher burnout, and yet much more is being demanded of teachers.

The authors believed that these tensions have resulted from change processes in education being viewed in isolation from the broader "systems" operating in the larger world.

Four ideas suggested as guides to the understanding of educational change are :

- Disequilibrium is everywhere, and we need to understand that.
- The brain is equipped to deal with a turbulent world. But to understand this, we first need to come to terms with how the brain learns and to see how this knowledge translates into our everyday lives.
- The change process is intrinsically transformational.
- To function best in this new environment, we need to embrace a fundamentally different world view or perceptual orientation.

For education to be successfully transformed, educators must first change themselves. And this begins with a paradigm shift from the prevailing worldview of schools as a big machine where all malfunctioning parts can be restructured to a self-organising, self-adapting system. What makes this change extremely difficult and frightening is that current systems are moving toward a state of disequilibrium or the "edge of chaos". The authors preferred to refer to this state as the "edge of possibility" because while these radical changes are uncontrollable and unpredictable, they can be influenced. Educators who are not willing to leave their comfort zones and suspend their traditional assumptions about teaching and learning may find difficulty, nevertheless those who boldly open themselves up to the possibilities of a new paradigm, thinking may begin to change.

Educators who are not willing to leave their comfort zones and suspend their traditional assumptions about teaching and learning may find difficulty.

The authors proceeded to distinguish between what they called Instructional Approaches 1,2 and 3. Instructional Approach 1 is known as the "stand-and-deliver" model that relies on top-down thinking and the control of information and facts to be disseminated by teachers. Instructional Approach 2 is still basically a command-and-control model but the emphasis is on creating meaning rather than merely for memorising, resulting in engaging experiences. Instructional Approach 3 is radically brain-

. . . education should emphasise the joy and enchantment that are intrinsic to human growth and the experience of relationship.

based, with student interests as its central focus. Students, consequently, are involved in meaningful and purposeful projects, approximating real-life experiences. These fundamental ways of looking at things are also described as "perceptual orientations". The authors preferred perceptual orientation 3 thinking to prevail as they believe that education should emphasise the joy and enchantment that are intrinsic to human growth and the experience of relationship.

Perceptual Orientation 3 where the 12 Brain/Mind Learning Principles are introduced :

Principle 1 : The brain is a complex-adaptive system
Principle 2 : The brain is a social brain
Principle 3 : The search for meaning is innate
Principle 4 : The search for meaning occurs through "patterning"
Principle 5 : Emotions are critical to patterning
Principle 6 : Every brain simultaneously perceives and creates parts and wholes
Principle 7 : Learning involves both focused attention and peripheral perception
Principle 8 : Learning always involves conscious and unconscious processes
Principle 9 : We have at least two ways of organising memory
Principle 10 : Learning is developmental
Principle 11 : Complex learning is enhanced by challenge and inhibited by threat
Principle 12 : Every brain is uniquely organised

Changing our thinking, both individually or collectively, is fundamental to the appreciation of the practice and implementation. On the outset, the authors knew that they were treading on rocky grounds as they perturbed stable systems and entrenched ways of thinking and doing things. Their approach at both schools in California, Dry Creek Elementary (K-6) in Rio Linda, and Park View Middle School in Yucaipa was to model what they believed in brain-based learning and to apply the theories. Although the two schools began with different backgrounds and experiences, Dry Greek being the one more supportive and "brain-friendly", the basic vehicle of change used was small "process groups" that powerfully helped people to bond as communities.

The brain-based programme used in both schools revealed that the following conditions supported teaching and learning :

- outcomes are relatively open-ended
- emphasis is on intrinsic motivation
- tasks have relatively open-ended time lines or time lines appropriate to the purpose of the task
- support for preferred work mode (group or alone) is available.

The authors consistently provided adequate degree of safety (relaxed alertness), supplied the essential raw material of all real change (orchestrated immersion in complex experience) and set in motion a depth of reflection and constant processing that would bring about new and higher-order mental models (active processing). Nevertheless, it is crystal clear that regardless of what new "method" or latest "technique" is attempted in bringing about brain-based learning or schools, the mind/brain will always choose to reduce such changes to fit existing entrenched mental models. Nothing changes as a result if existing current models remain unchanged.

Clearly, how much a reader is to benefit from the procedures and processes introduced in this book is highly dependent on the extent and quality of changes in thinking. Basically, building a learning community, where a system of values is shared and commonly understood among all staff is never easy. In Dry Creek, process groups were formed and the jelling of individual groups generated new insights into the nature of learning and teaching. A whole school approach included non-teaching staff and parents who deliberately made attempts to embed principles of brain-based learning. The sense of community or connectedness was very great. Perhaps, these would be good learning points for the grade-conscious Singaporeans. In the first two years, despite having won a California award as a distinguished school, Dry Creek did not have impressive standardised test scores. Academic improvement came only toward the end of the third year. And the impressive changes went beyond academic results. In Park View, there was much difficulty. Right from the start, people operated on differing values and purposes, thus there was little consensus. The larger system that self-organised around traditional ideas was hostile towards brain-based learning. Modestly, the authors concluded that they were moderately successful with helping teachers in the two schools to move out of an information delivery approach.

One very insightful distinction made by the authors with regards to teacher transformation is that there is a fundamental difference between acquiring new strategies and changing one's world view. Teacher development is powerful and long-termed only when

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The direction that education takes depends ultimately on the set of values and compelling beliefs that prevail. What we end up with depends as much on how all of us conceive and reconceive ouselves as it does on what we ask others to do".

mental models change. More insights about teacher training must be found in the authors' third book, "Unleashing the Power of Perceptual Change : The Potential of Brain-Based Teaching".

The authors also offered the following principles of facilitating self-organisation :

1 Complex self-adaptive systems self-organise as a matter of course
2 To induce change, disequilibrium must be recognised or introduced
3 The indispensable foundation for facilitating the emergence of a higher-order system is to create a deep sense of community that members intrinsically value
4 The dynamism of constant, in-depth learning, which is community-based and self-reflective, is the engine of transformation
5 The thrust of self-reference is to examine basic assumptions, especially those about how people learn
6 The total participation of upper-level management and decision makers is absolutely critical for change to be real.
7 A majority of the staff must be willing participants for an entire school to change
8 A group of teachers (the "heroes") who wish to explore new approaches ought to start work together first; and this will extend to the larger group as understanding and support grow

While the authors are uncertain about results, they are certain that the information explosion in neurosciences informing our understanding of learning and teaching will increasingly pose challenges to educators. And as the authors put it "*education, poised directly on the edge of chaos and possibility, will become as volatile as society as a whole. The direction that education takes depends ultimately on the set of values and compelling beliefs that prevail. What we end up with depends as much on how all of us conceive and reconceive ouselves as it does on what we ask others to do".*

Chan Poh Meng *is the Principal of Outram Secondary School*

Theory and Practice

Renate Nummela Caine & Geoffrey Caine

We work on the premise that body, mind and brain are a dynamic unity and that when we all understand what this means, changes in education follow. We have identified basic patterns of how human beings learn. We call these the Twelve Principles of Brain Based Learning.

Brain/Mind Learning Principles

Principle One: The brain is a complex dynamical system. Perhaps the most potent feature of the brain is its capacity to function on many levels and in many ways simultaneously. That is one reason why we have here subsumed two former principles ("The brain is a parallel processor" and Learning engages the entire physiology). Thoughts, emotions, imagination, predispositions and physiology operate concurrently and interactively as the entire system interacts with and exchanges information with its environment. Moreover, there are emergent properties of the brain as a whole system that can not be recognized nor understood when the parts alone are explored. Education MUST come to terms with the complex, multifaceted nature of the human learner.

Principle Two: The mind/brain is social. For the first year or two of life outside the womb, our brains are in the most pliable, impressionable, and receptive state they will ever be in (Zen Physics, P.18) We begin to be shaped as our immensely receptive brain/minds interact with our early environment and interpersonal relationships. Vygotsky was partially responsible for bringing the social construction of knowledge to our awareness. It is through this dynamical interaction with others that therapy works, for instance. It is now clear that throughout our lives, our brain/minds change in response to their engagement with others - so much so that individuals must always be seen to be integral parts of larger social systems. Indeed, part of our identity depends on establishing community and finding ways to belong. Learning, therefore, is profoundly influenced by the nature of the social relationships within which people find themselves.

Education MUST come to terms with the complex, multifaceted nature of the human learner.

The two brain doctrine is most useful for reminding us that the brain reduces information into parts and perceives holistically at the same time. Good training and education recognize this, for instance, by introducing natural "global" projects and ideas from the very beginning.

Principle Three: The search for meaning is innate. In general terms the search for meaning refers to making sense of our experiences. This is survival-oriented and basic to the human brain/mind. While the ways in which we make sense of our experience change over time, the central drive to do so is life long. At its core the search for meaning is purpose and value driven. Something of the extent of human purposes was expressed by Maslow. Included are such basic questions as who am I and why am I here? Thus, the search for meaning ranges from the need to eat and find safety, through the development of relationships and a sense of identity, to an exploration of our potential and the quest for transcendence.

Principle Four: The search for meaning occurs through patterning. In patterning we include schematic maps and categories, both acquired and innate. The brain/mind needs and automatically registers the familiar while simultaneously searching for and responding to novel stimuli. In a way, therefore, the brain/mind is both scientist and artist, attempting to discern and understand patterns as they occur and giving expression to unique and creative patterns of its own. It resists having meaninglessness imposed on it. By meaninglessness we mean isolated pieces of information unrelated to what makes sense to a particular learner. Really effective education must given learners an opportunity to formulate their own patterns of understanding.

Principle Five: Emotions are critical to patterning. What we learn is influenced and organized by emotions and mindsets involving expectancy, personal biases and prejudices, self-esteem and the need for social interaction. Emotions and thoughts literally shape each other and cannot be separated. Emotions color meaning. Metaphors are an example as Lakov so aptly describes. Moreover, the emotional impact of any lesson or life experience may continue to reverberate long after the specific event that triggers it. Hence an appropriate emotional climate is indispensable to sound education.

Principle Six: Every brain simultaneously perceives and creates parts and wholes. Although there is some truth to the left-brain right-brain distinction, that is not the whole story. In a healthy person, both hemispheres interact in every activity, from art and computing to sales and accounting. The two brain doctrine is most useful for reminding us that the brain reduces information into parts and perceives holistically at the same time. Good training and education recognize this, for instance, by introducing natural "global" projects and ideas from the very beginning.

Principle Seven: Learning involves both focused attention and peripheral perception. The brain absorbs information of which it is directly aware, but it also directly absorbs information that lies beyond the immediate focus of attention. In fact it responds to the larger sensory context in which teaching and communication occur. "Peripheral signals are extremely potent. Even the unconscious signals that reveal our own inner attitudes and beliefs have a powerful impact on students. Educators, therefore, can and should pay extensive attention to all facets of the educational environment.

Principle Eight: Learning always involves conscious and unconscious processes. One aspect of consciousness is awareness. Much of our learning is unconscious in that experience and sensory input is processed below the level of awareness. That means that much understanding may NOT occur during a class, but may occur hours, weeks or months later. It also means that educators must organize what they do so as to facilitate that subsequent unconscious processing of experience by students. In practice activities and ways to help learners creatively elaborate on the ideas, skills and experiences. Teaching largely becomes a matter of helping learners make visible what is invisible.

Principle Nine: We have at least two ways of organizing memory. Although there are many models of memory, one that provides an excellent platform for educators is the distinction made by O Keefe and Nadel between taxon and locale memories. They suggest that we have a set of systems for recalling relatively unrelated information (taxon systems, from taxonomies). These systems are motivated by reward and punishment.

O Keefe and Nadel also suggest that we have a spatial/ autobiographical memory which does not need rehearsal and allows for instant recall of experiences. This is the system that registers the details of your meal last night. It is always engaged, is inexhaustible and is motivated by novelty. Thus we are biologically supplied with the capacity to register complete experiences. It is through a combination of both approaches to memory that meaningful learning occurs. Thus meaningful and meaningless information are organized and stored differently.

Teaching largely becomes a matter of helping learners make visible what is invisible.

Principle Ten: Learning is developmental. Development occurs in several ways. In part, the brain is plastic. That means that much of its hard wiring is shaped by the experiences that people have. In part, there are predetermined sequences of development in

. . . there is no limit to growth and to the capacities of humans to learn more. Neurons continue to be capable of making new connections throughout life.

childhood, including windows of opportunity for laying down the basic hardware necessary for later learning. That is why new languages as well as the arts ought to be introduced to children very early in life. And finally, in many respects there is no limit to growth and to the capacities of humans to learn more. Neurons continue to be capable of making new connections throughout life.

Principle Eleven: Complex learning is enhanced by challenge and inhibited by threat. The brain/mind learns optimally - when it makes maximum connections - when appropriately challenged in an environment which encourages taking risks. However, the brain/mind downshifts under perceived threat. It then becomes less flexible, and reverts to primitive attitudes and procedures. That is why we must create and maintain an atmosphere of relaxed alertness, involving low threat and high challenge. However, low threat is NOT synonymous with simply "feeling good". The essential element of perceived threat is a feeling of helplessness or fatigue. Occasional stress and anxiety are inevitable and are to be expected in genuine learning. The reason is that genuine learning involves changes that lead to a reorganization of the self. Such learning can be intrinsically stressful, irrespective of the skill of, and support offered by, a teacher.

Principle Twelve: Every brain is uniquely organized. We all have the same set of systems, and yet are all different. Some of this difference is a consequence of our genetic endowment. Some of it is a consequence of differing experiences and differing environments. The differences express themselves in terms of learning styles, differing talents and intelligence and so on. An important corollary is both to appreciate that learners are different and need choice, while ensuring that they are exposed to a multiplicity of inputs. Multiple intelligence and vast ranges in diversity are, therefore, characteristic of what it means to be human.

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The First Seven . . . and the Eighth

Kathy Checkley

Howard Gardner's theory of multiple intelligences, described in Frames of Mind (1985), sparked a revolution of sorts in classrooms around the world, a mutiny against the notion that human beings have a single, fixed intelligence. The fervor with which educators embraced his premise that we have multiple intelligences surprised Gardner himself. "It obviously spoke to some sense that people had that kids weren't all the same and that the tests we had only skimmed the surface about the differences among kids," Gardner said.

Here Gardner brings us up-to-date on his current thinking on intelligence, how children learn, and how they should be taught.

How do you define intelligence?

Intelligence refers to the human ability to solve problems or to make something that is valued in one or more cultures. As long as we can find a culture that values an ability to solve a problem or create a product in a particular way, then I would strongly consider whether that ability should be considered an intelligence.

First, though, that ability must meet other criteria: Is there a particular representation in the brain for the ability? Are there populations that are especially good or especially impaired in an intelligence? And, can an evolutionary history of the intelligence be seen in animals other than human beings?

I defined seven intelligences (see box, p. 12) in the early 1980s because those intelligences all fit the criteria. A decade later when I revisited the task, I found at least one more ability that clearly deserved to be called an intelligence.

That would be the naturalist intelligence. What led you to consider adding this to our collection of intelligences?

Somebody asked me to explain the achievements of the great biologists, the ones who had a real mastery of taxonomy, who

Human intelligence continues to intrigue psychologists, neurologists, and educators. What is it? Can we measure it? How do we nurture it?

The naturalist intelligence refers to the ability to recognize and classify plants, minerals, and animals, including rocks and grass and all variety of flora and fauna.

understood about different species, who could recognize patterns in nature and classify objects. I realized that to explain that kind of ability, I would have to manipulate the other intelligences in ways that weren't appropriate.

So I began to think about whether the capacity to classify nature might be a separate intelligence. The naturalist ability passed with flying colors. Here are a couple of reasons: First, it's an ability we need to survive as human beings. We need, for example, to know which animals to hunt and which to run away from. Second, this ability isn't restricted to human beings. Other animals need to have a naturalist intelligence to survive. Finally, the big selling point is that brain evidence supports the existence of the naturalist intelligence. There are certain parts of the brain particularly dedicated to the recognition and the naming of what are called "natural" things.

How do you describe the naturalist intelligence to those of us who aren't psychologists?

The naturalist intelligence refers to the ability to recognize and classify plants, minerals, and animals, including rocks and grass and all variety of flora and fauna. The ability to recognize cultural artifacts like cars or sneakers may also depend on the naturalist intelligence.

Now, everybody can do this to a certain extent – we can all recognize dogs, cats, trees. But, some people from an early age are extremely good at recognizing and classifying artifacts. For example, we all know kids who, at age 3 or 4, are better at recognizing dinosaurs than most adults.

Darwin is probably the most famous example of a naturalist because he saw so deeply into the nature of living things.

Are there any other abilities you're considering calling intelligences?

Well, there may be an existential intelligence that refers to the human inclination to ask very basic questions about existence. Who are we? Where do we come from? What's it all about? Why do we die? We might say that existential intelligence allows us to know the invisible, outside world. The only reason I haven't given a seal of approval to the existential intelligence is that I don't think we have good brain evidence yet on its existence in the nervous system – one of the criteria for an intelligence.

You have said that the theory of multiple intelligences may be best understood when we know what it critiques. What do you mean?

The standard view of intelligences is that intelligence is something you are born with: "you have only a certain amount of it" you cannot do much about how much of that intelligence you have; and tests exist that can tell you how smart you are. The theory of multiple intelligences challenges that view. It asks, instead, "Given what we know about the brain, evolution, and the differences in cultures, what are the sets of human abilities we all share?"

My analysis suggested that rather than one or two intelligences, all human beings have several (eight) intelligences. What makes life interesting, however, is that we don't have the same strength in each intelligence area, and we don't have the same amalgam of intelligences. Just as we look different from one another and have different kinds of personalities, we also have different kinds of minds.

This premise has very serious educational implications. If we treat everybody as if they are the same, we're catering to one profile of intelligence, the language-logic profile, but it's not great for the vast majority of human beings who do not have that particular profile of intelligence.

Can you explain more fully how the theory of multiple intelligences challenges what has become known as IQ?

The theory challenges the entire notion of IQ. The IQ test was developed about a century ago as a way to determine who would have trouble in school. The test measures linguistic ability, logical-mathematical ability, and, occasionally, spatial ability.

What the intelligence test does not do is inform us about our other intelligences; it also doen't look at other virtues like creativity or civic mindedness, or whether a person is moral or ethical.

We don't do much IQ testing anymore, but the shadow of IQ tests is still with us because the SAT — arguably the most potent examination in the world — is basically the same kind of disembodied language-logic instrument.

The truth is, I don't believe there is such a general thing as scholastic aptitude. Even so, I don't think that the SAT will fade until colleges indicate that they'd rather have students who know

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The point is to realize that any topic of importance from any discipline, can be taught in more than one way.

how to use their minds well — students who may or may not be good test takers, but who are serious, inquisitive, and know how to probe and problem-solve. That is really what college professors want, I believe.

Can we strengthen our intelligences? If so, how?

We can all get better at each of the intelligences, although some people will improve in an intelligence area more readily than others, either because biology gave them a better brain for that intelligence or because their culture gave them a better teacher.

Teachers have to help students use their combination of intelligences to be successful in school, to help them learn whatever it is they want to learn, as well as what the teachers and society believe they have to learn.

Now, I'm not arguing that kids shouldn't learn the literacies. Of course they should learn the literacies. Nor am I arguing that kids shouldn't learn the disciplines. I'm a tremendous champion of the disciplines. What I argue against is the notion that there's only one way to learn how to read, only one way to learn how to compute, only one way to learn about biology. I think that such contentions are nonsense.

It's equally nonsensical to say that everything should be taught seven or eight ways. That's not the point of the MI theory. The point is to realize that any topic of importance from any discipline, can be taught in more than one way.

There are things people need to know, and educators have to be extraordinarily imaginative and persistent in helping students understand things better.

A popular activity among those who are first exploring multiple intelligences is to construct their own intellectual profile. It's thought that when teachers go through the process of creating such a profile, they're more likely to recognize and appreciate the intellectual strengths of their students. What is your view on this kinds of activity?

My own studies have shown that people love to do this. Kids like to do it, adults like to do it. And, as an activity, I think it's perfectly harmless.

I get concerned, though, when people think that determining your intellectual profile — or that of someone else — is an end in itself.

You have to use the profile to understand the ways in which you seem to learn easily. And, from there, determine how to use those strengths to help you become more successful in other endeavors. Then, the profile becomes a way for you to understand yourself better, and you can use that understanding to catapult yourself to a better level of understanding or to a higher level of skill.

How has your understanding of the multiple intelligences influenced how you teach?

My own teaching has changed slowly as a result of multiple intelligences because I'm teaching graduate students psychological theory and there are only so many ways I can do that. I'm more open to group work and to student projects of various sorts, but even if I wanted to be an "MI professor" of graduate students, I still have a certain moral obligation to prepare them for a world in which they will have to write scholarly articles and prepare theses.

Where I've changed much more, I believe, is at the workplace. I direct research projects and work with all kinds of people. Probably 10 to 15 years ago, I would have tried to find people who were just like me to work with me on these projects.

I've really changed my attitude a lot on that score. Now I think much more in terms of what people are good at and in putting together teams of people whose varying strengths complement one another.

Now I think much more in terms of what people are good at and in putting together teams of people whose varying strengths complement one another.

How should thoughtful educators implement the theory of multiple intelligences?

Although there is no single MI route, it's very important that a teacher take individual differences among kids very seriously. You cannot be a good MI teacher if you don't want to know each child and try to gear how you teach and how you evaluate to that particular child. The bottom line is a deep interest in children and how their minds are different from one another, and in helping them use their minds well.

Now, kids can be great informants for teachers. For example, a teacher might say, "Look, Benjamin, this obviously isn't working.

School matters, but only insofar as it yields something that can be used once students leave school.

Should we try using a picture?" If Benjamin gets excited about that approach, that's a pretty good clue to the teacher about what could work.

When I talk about understanding, I mean that students can take ideas they learn in school, or anywhere for that matter, and apply them appropriately in new situations. We know people truly understand something when they can represent the knowledge in more than one way. We have to put understanding up front in school. Once we have that goal, multiple intelligences can be a terrific handmaiden because understandings involve a mix of mental representations, entailing different intelligences.

People often say that what they remember most about school are those learning experiences that were linked to real life. How does the theory of multiple intelligences help connect learning to the world outside the classroom?

The theory of multiple intelligences wasn't based on school work or on tests. Instead, what I did was look at the world and ask. What are the things that people do in the world? What does it mean to be a surgeon? What does it mean to be a politician? What does it mean to be an artist or a sculptor? What abilities do you need to do those things? My theory, then came from the things that are valued in the world.

So when a school values multiple intelligences, the relationship to what's valued in the world is patent. If you cannot easily relate this activity to something that's valued in the world, the school has probably lost the core idea of multiple intelligences, which is that these intelligences evolved to help people do things that matter in the real world.

School matters, but only insofar as it yields something that can be used once students leave school.

How can teachers be guided by multiple intelligences when creating assessment tools?

We need to develop assessment that are much more representative of what human beings are going to have to do to survive in this society. For example, I value literacy, but my measure of literacy should not be whether you can answer a multiple-choice question that asks you to select the best meaning of a paragraph. Instead, I'd rather have you read the paragraph and list four questions you have about the paragraph and figure

out how you would answer those question. Or, if I want to know how you can write, let me give you a stem and see whether you can write about that topic, or let me ask you to write an editorial in response to something you read in the newspaper or observed on the street.

The current emphasis on performance assessment is well supported by the theory of multiple intelligences. Indeed, you could not really be an advocate of multiple intelligences if you didn't have some disatisfaction with the current testing because it's so focused on short-answer, linguistic, or logical kinds of items.

MI theory is very congenial to an approach that says: let's not look at things through the filter of a short-answer test. Let's look directly at the performance that we value, whether it's a linguistic, logical, aesthetic, or social performance; and, two, let's never pin our assessment of understanding on just one particular measure, but let's always allow students to show their understanding in a variety of ways.

Let's look directly at the performance that we value, whether it's a linguistic, logical, aesthetic, or social performance; and, two, let's never pin our assessment of understanding on just one particular measure, but let's always allow students to show their understanding in a variety of ways.

You have identified several myths about the theory of multiple intelligences. Can you describe some of those myths?

One myth that I personally find irritating is that an intelligence is the same as a learning style. Learning styles are claims about ways in which individuals purportedly approach everything they do. If you are planful, you are supposed to be planful about everything. If you are logical-sequential about everything. My own research and observations suggest that that's a dubious assumption. But whether or not that's true, learning styles are very different from multiple intelligences.

Multiple intelligences claims that we respond, individually, in different ways to different kinds of content, such as language or music or other people. This is very different from the notion of learning style.

You can say that a child is a visual learner, but that's not a multiple intelligences way of talking about things. What I would say is, "Here is a child who very easily represents things spatially, and we can draw upon that strength if need be when we want to teach the child something new."

Another widely believed myth is that, because we have seven or eight intelligences, we should create seven or eight tests to

As long as you can lose one ability while others are spared, you cannot just have a single intelligence. You have to have several intelligences.

measure students' strengths in each of those areas. That is a perversion of the theory. It's re-creating the sin of the single intelligence quotient and just multiplying it by a larger number. I'm personally against assessment of intelligences unless such a measurement is used for a very specific learning purpose — we want to help a child understand her history or his mathematics better and, therefore, want to see what might be good entry points for that particular child.

What experiences led you to the study of human intelligence?

It's hard for me to pick out a single moment, but I can see a couple of snap-shots. When I was in high school, my uncle gave me a textbook in psychology. I'd never actually heard of psychology before. This textbook helped me understand color blindness. I'm color blind, and I became fascinated by the existence of plates that illustrated what color blindness was. I could actually explain why I couldn't see color.

Another time when I was studying the Reformation, I read a book by Erik Erikson called Young Man Luther (1985).1 I was fascinated by the psychological motivation of Luther to attack the Catholic Church. That fascination influenced my decision to go into psychology.

The most important influence was actually learning about brain damage and what could happen to people when they had strokes. When a person has a stroke, a certain part of the brain gets injured, and that injury can tell you what that part of the brain does. Individuals who lose their musical abilities can still talk. People who lose their linguistic ability still might be able to sing. That understanding not only brought me into the whole world of brain study, but it was really the seed that led ultimately to the theory of multiple intelligences. As long as you can lose one ability while others are spared, you cannot just have a single intelligence. You have to have several intelligences. ■

[1] See Erik Erikson, Young Man Luther (New York: W. W. Norton, 1958).

Howard Gardner *is Professor of Education at Harvard Graduate School of Education and author of, among other books, The Unschooled Mind: How Children Think and How Schools Should Teach (1991). He can be reached at Roy B. Larsen Hall, 2nd Floor, Appian Way, Harvard Graduate School of Education, Cambridge, MA 02138.* ***Kathy Checkley*** *is a staff writer for Update and has assisted in the development of ASCD's new CD-ROM, Exploring Our Multiple Intelligences, and pilot online project on multiple intelligences.*

The Intelligences, in Gardner's Words

- Linguistic intelligence is the capacity to use language, your native language, and perhaps other languages, to express what's on your mind and to understand other people. Poets really specialize in linguistic intelligence, but any kind of writer, orator, speaker, lawyer, or a person for whom language is an important stock in trade highlights linguistic intelligence.

- People with a highly developed logical-mathematical intelligence understand the underlying principles of some kind of a causal system, the way a scientist or a logician does; or can manipulate numbers, quantities, and operations, the way a mathematician does.

- Spatial intelligence refers to the ability to represent the spatial world internally in your mind — the way a sailor or airplane pilot navigates the large spatial world, or the way a chess player or sculptor represents a more circumscribed spatial world. Spatial intelligence can be used in the arts or in the sciences. If you are spatially intelligent and oriented toward the arts, you are more likely to become a painter or a sculptor or an architect than, say, a musician or a writer. Similarly, certain sciences like anatomy or topology emphasize spatial intelligence.

- Bodily kinesthetic intelligence is the capacity to use your whole body or parts of your body — your hand, your fingers, your arms — to solve a problem, make something, or put on some kind of a production. The most evident examples are people in athletics or the performing arts, particularly dance or acting.

- Musical intelligence is the capacity to think in music, to be able to hear patterns, recognize them, remember them, and perhaps manipulate them. People who have a strong musical intelligence don't just remember music easily — they can't get it out of their minds, it's so omnipresent. Now, some people will say, "Yes, music is important, but it's a talent, not an intelligence." And I say, "Fine, let's call it a talent." But, then we have to leave the word intelligent out of all discussions of human abilities. You know, Mozart was damned smart!

- Interpersonal intelligence is understanding other people. It's an ability we all need,but is at a premium if you are a teacher, clinician, salesperson, or politician. Anybody who deals with other people has to be skilled in the interpersonal sphere.

- Intrapersonal intelligence refers to having an understanding of yourself, of knowing who you are, what you can do, what you want to do, how you react to things, which things to avoid, and which things to gravitate toward. We are drawn to people who have a good understanding of themselves because those people tend not to screw up. They tend to know what they can do. They tend to know what they can't do. And they tend to know where to go if they need help.

- Naturalist intelligence designates the human ability to discriminate among living things (plants, animals) as well as sensitivity to other features of the natural world (clouds, rock configurations). This ability was clearly of value in our evolutionary past as hunters, gatherers, and farmers; it continues to be central in such roles as botanist or chef. I also speculate that much of our consumer society exploits the naturalist intelligences, which can be mobilized in the discrimination among cars, sneakers, kinds of makeup, and the like. The kind of pattern recognition valued in certain of the sciences may also draw upon naturalist intelligence.

TEACHING TIPS & WONDER WEBS

Efficient, Effective, and Excellence

EFFICIENT : Doing things right.
EFFECTIVE : Doing the right things consistently.
EXCELLENCE : Being efficient and effective.

The successful teacher is efficient.

The teacher who is often efficient is effective.

The teacher who is effective affects lives.

The teacher who affects lives achieves excellence.

Grouping Increases Learning

Twenty or more hands are waving, all signalling for help. And you are frantically running around the room, desperately trying to help each child.

There is no need to run from student to student, because every student really doesn't need your help.

Use cooperative learning as a classroom management system (Chapter 24, The First Days of School). Cooperative learning requires that your students rely on each other and themselves for help. Cooperative learning teaches your students self-discipline and self-responsibility as it applies to working cooperatively in a group. There is more evidence validating the use of cooperative learning than any other aspect of education.

Instead of having groups or teams, organize your class into Support Groups with each member of the group known as a Support Buddy. The world is full of support groups, people helping people. There are support groups for senior citizens, alcoholics, cancer patients, battered women, abused children, and war veterans. Children are at an age when they need lots of support. Instead of isolating them with seat work, surround them with support buddies and teach them how to support others.

Reducing Stress

Ineffective teachers divide students into groups and expect the students to work together. Effective teachers teach social skills and procedures needed for functioning in a group.

Group Procedures

1. You are responsible for your own work and behaviour.
2. You must ask each Support Buddy for help if you have a question.
3. You must be willing to help any Support Buddy who asks for help.
4. You may ask for help from the teacher only when the group has reached consensus with the same question.

Students are instructed not to raise their hands when they have a question, but to ask a support buddy first, then another. When all group members agree that they cannot answer, they carefully rephrase the question and appoint one person to ask it. Two things happen: 1) you reduce 75% of the hands waving in the air and 2) the only hands waving are those with carefully thought-out group questions. Just think how much easier life would be for a teacher who teaches the procedures for cooperative learning.

Organizing

The question is often asked, "How do I divide my class into groups?" The question is not germane because there are no permanent groups in cooperative learning. The question is how quickly and effectively the class will divide itself when the students are asked to do so. Effective grouping is dependent on two major factors: 1) the class climate and 2) the explanation. These are explained fully in the book, The First Days of School.

Telling the students to break up into groups is easy if the students are successful in class. It is the responsibility of the teacher to facilitate this success. In a successful classroom, the students respect the teacher's ability to move them quickly into groups for work.

Simply tell your students that the nature of the activity determines the composition and length of the groups.

Groups should be small, heterogeneous, and mixed-ability groups. The grouping should be done on a random basis. This eliminates cliques working together and excluding others or arguing about team-mates. Stress that an important adult lifeskill is the ability to work well in a workplace with different people in different groups on different tasks.

Maintaining Participation

Groups are to be divided by the number of jobs, not by the number of people. The number of people in a group must equal the number of jobs in the group. People do not go through life always working, say, in groups of four. The task always specifies the optimum number of people needed.

The reason some students do nothing or copy from other students is that they do not have specific tasks or jobs. Determine the number of students you need to accomplish an activity, divide

the class accordingly, and then spell out the assignments. For instance, in a group of four:

Student 1 is responsible for getting the materials and returning them to the appropriate place when the day or period is over.

Student 2 is responsible for seeing that the steps of the activity are followed.

Student 3 is responsible for making observations, recording data, and taking minutes as the activity progresses.

Student 4 is responsible for overseeing the writing of the group report.

The Teacher's Role

The teacher has two major roles. The first is to consistently and assertively work at making the concept of working in groups a valuable life skill that the students can use as adults. Second, to model cooperative working in groups. Rather than answer questions, join the group and be a questioner. Leave when they are back on their own.

Tactics that Encourage Active Learning

The use of the following tactics during class will ensure that students are actively engaged in thinking about the content. Students should be called on randomly (using the deck of cards method for instance) so that everyone participates. When students do not know when they will be called on they are much more likely to remain alert and engaged in the learning process. Students should be routinely called upon to:

1. Summarize or put into their own words what the teacher or another student has said.
2. Elaborate on what they have said.
3. Relate the issue or content to their own knowledge and experience.
4. Give examples to clarify or support what they have said.
5. Make connections between related concepts.
6. Restate the instructions or assignment in their own words.
7. State the question at issue.
8. Describe to what extent their point of view on the issue is different from or similar to the point of view of the instructor, other students, the author, etc.
9. Take a few minutes to write down any of the above.
10. Write down the most pressing question on their mind at this point. The instructor then uses the above tactics to help students reason through the questions.
11. Discuss any of the above with a partner and then participate in a group discussion facilitated by the instructor.

Source : http:www.sonoma.edu/cthink/kiz/k/2class/tactis.nclk

WONDER WEBS

In Unleashing the Power of Perceptual Change, Renate and Geoffrey Caine recommend that teacher preparation programs include "understanding technology" as a primary focus. Here you will find sites that will help you "infuse technology into lives filled with meaning and purpose" – one of the objectives of brain-based learning and teaching.

Kids Love the Brain

http://www.exploratorium.org/memory/index.html
Explore Memory at the Exploratorium, a museum (both virtual and real) of "science, art, and human perception" in San Francisco. Here, play Memory Solitaire and Memory Party Games. Play with Droodles and Common Cents. Expand your brain.

http://weber.u.washington.edu/~chudler/neurok.html
Kids and adults will like this friendly site sponsored by the National Institutes of Health's National Center for Research Resources. Neuroscience for Kids is a rich resource of graphics, information, and interactivity developed by Eric H. Chudler of the University of Washington. Find out where to order a brain – animal, gelatin, rubber, or plastic. This site is for serious biological students and for people just fascinated by how the brain works.

Let's Go Back to School

http://www.newhorizons.org/blab.html
New Horizons, a nonprofit organization in Washington State, hosts "The Brain Lab," a compendium of full-text articles and resources, including reviews of Robert Sylwester's ASCD book A Celebration of Neurons, articles by Renate and Geoffrey Caine and Marian Diamond, and links to the other leading educators. Check out the online journal for related articles. Note: This site also includes some of the links published here.

http://www.cnbc.cmu.edu/other/homepages.html
Lots of opportunities for adult learning are found at "Cognitive Neuroscience Resources on the Internet." From Harvard University (check the Whole Brain Atlas – http://www.med.harvard.edu/AANLIB/home.html – which is really for adults and older students) to the Australian National University to the University of Turku in Finland – here are many centers, research groups, laboratories, and institutes studying how the brain learns.

The Brain Needs Content

http://www.c3.lanl.gov/mega-math/
Let's go the Los Alamos National Laboratory for "This Is Mega-Mathematics!" and tons of brain games, such as "A Usual Day at Unusual School" and "Welcome to Hotel Infinity." Here are links to other mathematical sites, such as SAMI, Science and Math Initiatives of the Annenberg/CPB Science and Math Project (http://www.learner.org/sami/), and TAP: Tapping Internet Resources for Women in Computer Science (http://www.cs.yale.edu/HTML/YALE/CS/HyPlans/tap/).

http://rsb.info.nih.gov/nih-image/about.html
Can technology connect subject matter and art? "Image can acquire, display, edit, enhance, analyze and animate images. It reads and writes TIFF, PICT, PICS and MacPaint files, providing compatibility with many other applications, including programs for scanning, editing, publishing and analyzing images (Mac version; PC version available free from the Scion Corp.: http://www.scioncorp.com/)." This from the National Institutes of Health. Is this connectedness or what?

http://www.musica.uci.edu/index.html
MuSICA can answer questions like these: What effect does music have on learning? Should I play Mozart to my unborn baby? How does music affect emotion? An online journal publishes articles by Norman M. Weinberger, a professor at the Center for the Neurobiology of Learning and Memory, University of California at Irvine. The site houses a vast, searchable archive of abstracts and summaries of research related to music and learning – including and article titled "Bach Is Not Enough."

– Compiled by Carolyn R. Pool, Associate Editor, ASCD Books. "Web Wonders" also appears in the *ASCD Education Bulletin*, under Publications on the ASCD Wed (http://www.ascd.org)

A Call of Articles . . .

The ASCD (Singapore) REVIEW Committee seeks original articles on teaching and learning . . .

Manuscripts should be between 2000-2500 words, typewritten (preferably Microsoft Word document) and submitted in hard copy together with a $3^1/_2$ inch diskette. Photographs would be appreciated. Contributions may be addressed to:

Mrs Marian Chia
ASCD (Singapore) REVIEW Committee
c/o Schools Division
Ministry of Education
Kay Siang Road
Singapore 248922
email : CHIA_Siew_Yong@MOE.gov.sg

The themes for the forthcoming issues are:

Vol 8 No 3: **Integrating IT in Schools**
Deadline for articles: 1 May 99

Vol 9 No 1: **Working with Parents and the Community**
Deadline for articles: 1 August 99