REVIEW

Vol 3 No 2 Mar 1993 MITA (P) No 572/09/92

Teaching Strategies

Association for Supervision and Curriculum Development (Singapore)

ASSOCIATION FOR SUPERVISION AND CURRICULUM DEVELOPMENT

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ASCD (Singapore) Review is published three times a year in March, July and November. The views expressed in this journal do not necessarily reflect the official position of ASCD (Singapore).

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Published by Association for Supervision and Curriculum Development (Singapore).

Printed by Mentor Printers Pte Ltd, Blk 155, Kallang Way #01-03, Singapore 1334.

Association for Supervision & Curriculum Development (Singapore)
REVIEW
March 1993 Vol 3 No 2

FOCUS: Teaching Strategies

OTHER TOPICS

JERE BROPHY

Probing the Subtleties of Subject-Matter Teaching

Building on the effective schools research of the 1970s, studies today focus on teaching for understanding and use of knowledge.

Research on teaching, if interpreted appropriately, is a significant resource to teachers; it both validates good practice and suggests directions for improvement. All too often, however, reviews of the research assume an "out with the old, in with the new" stance, which fosters swings between extremes. Practitioners are left confused and prone to believe that research is not helpful. This summary of the research conducted during the last 25 years attempts not only to highlight the changing implications of research but also to emphasize how the research has built on what was learned before.

Process-Outcome Research

Especially relevant findings come from studies designed to identify relationship between classroom processes (what the teacher and students do in the classroom) and student outcomes (changes in students' knowledge, skills, values, or dispositions that represent progress toward instructional goals). Two forms of *process-outcome research* that became prominent in the 1970s were school effects research and teacher effects research.

School effects research (reviewed in Good and Brophy 1986) identified characteristics in schools that elicit good achievement gains from their students: (1) strong academic leadership that produces consensus on goal priorities and commitment to instructional excellence; (2) a safe, orderly school climate; (3) positive teacher attitudes towards students and expectations regarding their abilities to master the curriculum; (4) an emphasis on instruction in the curriculum (not just on filling time or on nonacademic activities); (5) careful monitoring of progress toward goals through student testing and staff evaluation programs; (6) strong parent involvement programs; and (7) consistent emphasis on the importance of academic achievement, including praise and public recognition for students' accomplishment.

Teacher effects research (reviewed in Brophy and Good 1986) identified teacher behaviors and patterns of teacher-student interaction associated with student achievement gains. This research firmly established three major conclusions:

1. *Teachers make a difference.* Some teachers reliably elicit greater gains than others, because of differences in how they teach.

2. *Differences in achievement gains occur in part because of differences in exposure to academic content and opportunity to learn.* Teachers who elicit greater gains: (a) place more emphasis on developing mastery of the curriculum, in establishing expectations for students, and defining their own roles; (b) allocate most of the available time for activities designed to foster such mastery; and (c) are effective organizers and managers who make their classrooms efficient learning environments, minimize the time spent getting organized or making transitions, and maximize student engagement in ongoing academic activities.

3. *Teachers who elicit greater achievement gains do not merely maximize "time on task"; in addition, they spend a great deal of time actively instructing their students.* Their classrooms feature more time spent in interactive lessons, featuring much teacher-student discourse and less time spent in independent seat-work. Rather than depend solely on curriculum materials as content sources, these teachers interpret and elaborate the content for students, stimulate them to react to it through questions, and circulate during seat-work times to monitor progress and provide assistance. They are active instructors, not just materials managers and evaluators, although most of their instruction occurs during interactive discourse with students rather than during extended lecture-presentations.

The process-outcome research of the 1970s was important, not only for contributing the findings summarized above but also for providing education with a knowledge base capable of moving the field beyond testimonials and unsupported claims toward scientific statements based on credible data. However, this research was limited in several respects. First, it focused on important but very basic aspects of teaching. These aspects differentiate the least effective teachers from other teachers, but

By constructing from balsa wood a model of a residential home, students in John Ponseigo's drafting class in Littleton, Colorado, show that they have made knowledge of engineering their own.

they do not include the more subtle points that distinguish the most outstanding teachers.

Second, most of this research relied on standardized tests as the outcome measure, which meant that it focused on mastery of relatively isolated knowledge items and skill components without assessing the degree to which students had developed understanding of networks of subject-matter content or the ability to use this information in authentic application situations.

Research on Teaching for Understanding and Use of Knowledge

During the 1980s, research emerged that emphasized teaching subject matter for understanding and use of knowledge. This research focuses on particular curriculum units or even individual lessons, taking into account the teacher's instructional goals and assessing student learning accordingly. The researchers find out what the teacher is trying to accomplish, record detailed information about classroom processes as they unfold, and then assess learning using measures keyed to the instructional goals. Often these include detailed interviews or portfolio assessments, not just conventional short-answer tests.

Current research focuses on attempts to teach both the individual elements in a network or related content and the connections among them, to the point that students can explain the information in their own words and use it appropriately in and out of school. Teachers accomplish this by explaining concepts and principles with clarity and precision and by modeling the strategic application of skills via "think aloud" demonstrations. These demonstrations make overt for students the usually covert strategic thinking that guides the use of the skills for problem solving.

Construction of Meaning

Current research, while building on findings indicating the vital role teachers play in stimulating student learning, also focuses on the role of the student. It recognizes that students do not merely passively receive or copy input from teachers, but instead actively mediate it by trying to make sense of it and to relate it to what they already know (or think they know) about the topic. Thus, students develop new knowledge through a process of *active construction*. In order to get beyond rote memorization to achieve true understanding, they need to develop and integrate a network of associations linking new input to preexisting knowledge and beliefs anchored in concrete experience. Thus, teaching involves inducing *conceptual change* in students, not infusing knowledge into a vacuum. Students' misconceptions, however, must be corrected so that they do not distort the new learning.

To the extent that new learning is complex, the construction of meaning required to develop clear understanding of it will take time and will be facilitated by the interactive *discourse* that occurs during lessons and activities. Clear explanations and modeling from the teacher are important, but so are opportunities to answer questions about the content, discuss or debate its meanings and implications, or apply it in authentic problem-solving or decision-making contexts. These activities allow students to process the content actively and "make it their own" by paraphrasing it into their own words, exploring its relationships to other knowledge and to past experience, appreciating the insights it provides, or identifying its implications for personal decision making or action. Increasingly, research is pointing to thoughtful discussion, and not just teacher lecturing or student recitation, as characteristic of the discourse involved in teaching for understanding.

Researchers have also begun to stress the complementary changes in teacher and student roles that should occur as learning progresses. Early in the process, the teacher assumes most of the responsibility for structuring and managing learning activities and provides students with a great deal of information, explanation, modeling and cueing. As students develop expertise, however, they can begin regulating their own learning by asking questions and by

working on increasingly complex applications with increasing degrees of autonomy. The teacher still provides task simplification, coaching, and other "scaffolding" needed to assist students with challenges that they are not yet ready to handle on their own. Gradually, this assistance is reduced in response to gradual increases in student readiness to engage in self-regulated learning.

Principles of Good Subject Matter Teaching

Although research on teaching school subjects for understanding and higher-order applications is still in its infancy, it already has produced successful experimental programs in most subjects. Even more encouraging, analyses of these programs have identified principles and practices that are common to most if not all of them (Anderson 1989, Brophy 1989, Prawat 1989). These common elements are:

1. The curriculum is designed to equip students with knowledge, skills, values, and dispositions useful both inside and outside of school.
2. Instructional goals underscore developing student expertise within an application context and with emphasis on conceptual understanding and self-regulated use of skills.
3. The curriculum balances breadth with depth by addressing limited content but developing this content sufficiently to foster understanding.
4. The content is organized around a limited set of powerful ideas (key understandings and principles).
5. The teacher's role is not just to present information but also to scaffold and respond to students' learning.
6. The students' role is not just to absorb or copy but to actively make sense and construct meaning.
7. Activities and assignments feature authentic tasks that call for problem solving or critical thinking, not just memory or reproduction.
8. Higher-order thinking skills are not taught as a separate skills curriculum. Instead, they are developed in the process of teaching subject-matter knowledge within application contexts that call for students to relate what they are learning to their lives outside of school by thinking critically or creatively about it or by using it to solve problems or make decisions.
9. The teacher creates a social environment in the classroom that could be described as a learning community where dialogue promotes understanding.

Thoughtful discussion is essential in the process of teaching for understanding. Here, Cheri Murphy, a teacher in a Colorado Higher Literacy Project, confers with a student about her writing.

In-Depth Study of Fewer Topics

Embedded in this approach to teaching is the notion of "complete" lessons carried through to include higher-order applications of content. The breadth of content addressed, thus, is limited to allow for more in-depth teaching of the content. Unfortunately, typical state and district curriculum guidelines feature long lists of items and subskills to be "covered", and typical curriculum packages supplied by educational publishers respond to these guidelines by emphasizing breadth over depth of coverage. Teachers who want to teach for understanding and higher-order applications of subject-matter will have to both:

(1) limit what they teach by focusing on the most important content and omitting or skimming over the rest, and (2) structure what they do teach around important ideas, elaborating it considerably beyond what is in the text.

Besides presenting information and modeling skill applications, such teachers will need to structure a great deal of thoughtful discourse by using questions to stimulate students to process and reflect on the content, recognize relationships among and implications of its key ideas, think critically about it, and use it in problem-solving or decision-making applications. Such discourse downplays rapid-fire questioning and short answers and instead features sustained examination of a small number of related topics. Students are invited to develop explanations, make predictions, debate alternative approaches to problems, or otherwise consider the content's implications or applications. Some of the questions admit to a range of possible correct answers, and some invite discussion or debate (for example, concerning the relative merits of alternative suggestions for solving problems). In

addition to asking questions and providing feedback, the teacher encourages students to explain or elaborate on their answers or to comment on classmates' answers. The teacher also capitalizes on "teachable moments" offered by students' comments or questions (by elaborating on the original instruction, correcting misconceptions, or calling attention to implications that have not been appreciated yet).

Holistic Skills Instruction

Teaching for understanding and use of knowledge also involves holistic skills instruction, not the practice of skills in isolation. For example, most practice of writing skills is embedded within activities calling for authentic writing. Also, skills are taught as strategies adapted to particular purposes and situations, with emphasis on modeling the cognitive and metacognitive components involved and explaining the necessary conditional knowledge (of when and why the skills would be used). Thus, students receive instruction in when and how to apply skills, not just opportunities to use them.

Activities, assignments, and evaluation methods incorporate a much greater range of tasks than the familiar workbooks and curriculum-embedded tests that focus on recognition and recall of facts, definitions, and fragmented skills. Curriculum strands or units are planned to accomplish gradual transfer of responsibility for managing learning activities from the teacher to the students, in response to their growing expertise on the topic. Plans for lessons and activities are guided by overall curriculum goals (phrased in terms of student capabilities to be developed), and evaluation efforts concentrate on assessing the progress made.

Reading. Reading is taught as a sense-making process of extracting meaning from texts that are read for information or enjoyment, not just for practice. Important skills such as decoding, blending, and noting main ideas are taught and practiced, but primarily within the context of reading for meaning. Activities and assignments feature more reading of extended texts and less time spent with skills worksheets. Students often work cooperatively in pairs or small groups, reading to one another or discussing their answers to questions about the implications of the text. Rather than being restricted to the artificial stories written for basal readers, students often read literature written to provide information or pleasure (Anderson et al. 1985, Dole et al. 1991).

Clearly, the kind of instruction described here demands more from both teachers and students than traditional reading-recitation-seatwork teaching does.

Writing. Writing is taught as a way for students to organize and communicate their thinking to particular audiences for particular purposes, using skills taught as strategies for accomplishing these goals. Most skills practice is embedded within writing activities that call for composition and communication of meaningful content. Composition activities emphasize authentic writing intended to be read for meaning and response. Thus, composition becomes an exercise in communication and personal craftsmanship. Students develop and revise outlines, develop successive drafts for meaning, and then polish their writing. The emphasis is on the cognitive and metacognitive aspects of composing, not just on mechanics and editing (Englert and Raphael 1989, Rosaen 1990, Scardamalia and Bereiter 1986).

Mathematics. Mathematics instruction focuses on developing students' abilities to explore, conjecture, reason logically, and use a variety of mathematical models to solve non-routine problems. Instead of working through a postulated linear hierarchy from isolated and low-level skills to integrated and higher-level skills, and only then attempting application, students are taught within an application context right from the beginning through an emphasis on authentic problem solving. They spend less time working individually on computation skills sheets and more time participating in teacher-led discourse concerning the meanings of the mathematical concepts and operations under study (Carpenter et al. 1989; National Council of Teachers of Mathematics 1989, 1991; Steffe and Wood 1990).

Science. In science, students learn to understand, appreciate, and apply connected sets of powerful ideas that they can use to describe, explain, make predictions about, or gain control over real-world systems or events. Instruction connects with students' experience-based knowledge and beliefs, building on accurate current knowledge but also producing conceptual change by confronting and correcting misconceptions. The teacher models and coaches the students' scientific reasoning through scaffolded tasks and dialogues that engage them in thinking about scientific issues. The students are encouraged to make predictions or develop explanations, then subject them to empirical tests or argue the merits of proposed alternatives (Anderson and Roth 1989, Neale et al. 1990).

Social Studies. In social studies, students are challenged to engage in higher-order thinking by interpreting, analyzing, or manipulating information in response to questions or problems that cannot be resolved through routine application of pre-

viously learned knowledge. Students focus on networks of connected content structured around powerful ideas rather than on long lists of disconnected facts, and they consider the implications of what they are learning for social and civic decision making. The teacher encourages students to formulate and communicate ideas about the topic, but also presses them to clarify or justify their assertions rather than merely accepting and reinforcing them indiscriminately (Brophy 1990, Newmann 1990).

Greater Efforts, Greater Rewards

The type of teaching described here is not yet typical of what happens in most schools. For it to become more common, several things must occur. First, researchers need to articulate these principles more clearly. Second, states and districts must adjust their curriculum guidelines, and publishers must modify their textbooks and teachers' manual. Finally, professional organizations of teachers and teacher educators must build on the beginnings that they have made in endorsing the goals of teaching subjects for understanding, appreciation, and life application by creating and disseminating position statements, instructional guidelines, videotaped examples, and other resources for preservice and inservice teachers. Clearly, the kind of instruction described here demands more from both teachers and students than traditional reading-recitation-seatwork teaching does. However, it also rewards their efforts with more satisfying and authentic accomplishments.

Author's note: This work is sponsored in part by the Center for the Learning and Teaching of Elementary Subjects, Institute for Research on Teaching, Michigan State University. The Center for Learning and Teaching of Elementary Subjects is funded primarily by the Office of Educational Research and Improvement, U.S. Department of Education. The opinions expressed here do not necessarily reflect the position, policy, or endorsement of the Office or Department (Cooperative Agreement No. G0087C0226).

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GAEA LEINHARDT

What Research on Learning Tells Us About Teaching

Three insights - that there are multiple forms of learning, that students must build on prior knowledge, and that learning is a social act - have important implications for teachers.

What's new in the research on learning that affects teaching? Over the last decade, we've seen a plethora of new terms, approaches to research, and evidence on the nature of learning. *Authentic activity, apprenticeship learning, case-based research, conceptual change, constructivism, distributed knowledge, narrative/episodic knowledge structure,* and *socially shared cognition* are terms that abound in the literature. Three constructs are fundamental to these terms: (1) the multiple forms of knowledge, (2) the role of prior knowledge, and (3) the social nature of knowledge and its acquisition.

Multiple Kinds of Knowledge

The first finding is that there are both different kinds and amounts of knowledge. This does not simply mean, as it did with Bloom's taxonomy, that there are different levels or depths of knowledge. It means that there are both knowledge of actions and skills and knowledge of concepts and principles. The student's task is to connect strategic action knowledge with specific content knowledge.

When we examine the kinds of information and generative power we expect students to develop, we realize that knowledge varies both *within* and *across* subject-matter areas. Knowledge varies *across* subject matter because subjects have different arrangements of facts, concepts, notations, and patterns of reasoning. Knowledge varies *within* subjects because some academic subjects have elaborate and importantly constraining notational systems. A map is not like a musical score, which is not like the equation for a function, which in turn differs from an evolutionary tree.

Other disciplines have intricately layered ways of developing arguments and handling evidence (for example, history and literature), while still others require documentation of procedures in highly codified ways (chemistry and biology). In organic chemistry, the facts and rich combination of taxonomy, algebra, and geometry form a conceptual basis of knowledge and a powerful clue as to the actions that a chemistry student performs. That knowledge simply does not look or feel like the knowledge necessary to form an historical argument or to construct an explanation in biology.

In classrooms that reflect learning's social nature, students are active constructors of knowledge. Shown here are students from Douglas County School District's Higher Literacy Project.

In addition to knowledge of parts of a subject, knowing what you know (metaknowledge) and how well you know it is also important. As research has pointed out, skilled performers within a knowledge domain have extensive awareness of their own knowledge. A competent reader is aware of character, plot, and prediction. A competent science student constantly constructs personal explanations of new material, forcing it to be consistent with the fundamental design of the prior information.

These multiple forms of knowledge render learning and performing tasks more complex. Consider a social studies class discussing why in the move westward of American pioneers, the Midwest was settled after the West Coast. One explanation might include the following arguments: News of the gold rush in California prompted the pioneers to bypass this territory. Further, severe conditions in the Midwest - for example, extreme weather conditions and hostile interactions with Native Americans - made it appear undesirable for settlement. The task for students is to construct an explanation of this pattern of settlement that synthesizes various kinds of information. To do so, students need to understand the principles of forming an explanation in social studies; the history of the time and the geography of the United States; be able to use the representational systems of maps; and monitor their own oral discussions as they produce the explanation.

This example points up the particular use of different kinds of knowledge in performing a relatively simple and common school activity. The existence of different kinds of knowledge has implications for both teaching and learning. Any one of these types or forms of knowledge can be taught and learned in a way that results in inert, disconnected information rather than principled, generative ideas. Simply saying that different disciplines have different notational systems, rules of evidence, or deductive properties does not give

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teachers or students much to go on in terms of issues of sequence, complexity, or active experiences for learning.

One pedagogical problem is how to transform what has traditionally been regarded as a linear process of knowledge acquisition into a multifaceted system. Such a system must include the content of a field such as history or mathematics (for example, the gradual elimination of slavery or the number system) and the actions of the field (explaining and interpreting, or posing problems).

Another difficulty is how to help develop in students a focus on deeply principled aspects of knowledge as opposed to shallower ones. Clearly, teaching the underlying principles alone does not improve performance, but, equally clearly, performance proficiency does not produce conceptual understanding. One suggestion is to consistently teach these different kinds of knowledge together in action, explicitly acknowledging how the different forms of knowledge work together. The pieces of needed knowledge are seen as working together when the acts of problem posing, solution, and learning are public and shared.

Role of Prior Knowledge

What kinds and amounts of knowledge one has before encountering a given topic in a discipline affect how one constructs meaning. The impact of prior knowledge is not a matter of "readiness", component skills, or exhaustiveness; it is an issue of depth, interconnectedness, and access. It includes all of the kinds of knowledge described above and their interrelationships - and is the source of both conceptions and misconceptions. Learning outcomes are determined jointly by what was known before and by the content of the instruction.

Prior knowledge also dramatically influences the processing of new information. It affects how students make sense of instruction both in a facilitative sense and in a dysfunctional sense. For example, how we read a text is influenced by what we expect (from previous experience) to find there and how that material is parsed. Thus, a headline such as *Vikings Cream Dolphins* has a different meaning depending on whether we are thinking about the eating habits of ancient seafarers or about U.S. football teams. Similarly, if one believes that light emanates from an object (as many naive science students seem to believe), then science textbook diagrams such as those showing dotted lines between the human eye and a perceived object have a different meaning and interpretation than they would if one believed objects are seen because of reflected light.

Knowledge is a complex network of ideas, facts, principles, actions, and scenes; therefore, prior knowledge is more than a building block of information. It can facilitate, inhibit, or transform a common learning task. Consider the common use of base-ten blocks (Dienes blocks) in teaching arithmetic. Dienes blocks are often used to provide a concrete representation of "regrouping" in addition. Students work carefully through several different mathematical tasks in which they trade Dienes blocks of

different values (for example, 9 single blocks and 7 single blocks may be traded for 1 tens block and 6 ones blocks). When students then encounter the use of Dienes blocks in an introductory lesson for another piece of mathematics, such as the regrouping necessary in some subtraction problems, students who have prior knowledge of the actions and meanings of the blocks are no doubt in better shape than those who do not have this prior knowledge and who must learn both the meaning of the concrete representation and the arithmetic simultaneously.

Suppose, on the other hand, a student who has worked extensively with these base-ten blocks in the whole number domain is asked to use them for decimal fractions. Although this is often recommended, it can be problematic. The switch from the large cube's familiar representational meaning of one thousand (with 10 small cubes on each row of each face and 100 cubes on a face) to a new meaning of one whole is possibly confusing. When the large thousand cube represents thousandths, its construction suggests that decimals can only go down to one thousandth. Further, the very thing that makes decimals different from whole numbers, the shift from the infinite to the infinitesimal, is blurred. In this case, the prior knowledge of the representational system - the Dienes blocks - could inhibit the learning of the new material.

Finally, consider a student who has no knowledge of either the blocks or the rules of working with them. For that student, demonstrations with the blocks and their trading of tens for ones and hundreds for tens becomes an object for learning in and of itself. Further, learning the analogical mapping between the blocks and the symbolic number system becomes a second task, requiring serious revising of the learner's initial understanding. Subtracting with blocks involves no place value, in the sense of right or left placement; the value is in the blocks themselves. Using the blocks for substraction with regrouping requires a "bank" to which one can go for denominational exchanges.

Both of these circumstances are reversed when a student is working in the symbolic number system. The student who is to use the blocks to learn substraction with regrouping and to gain a deeper insight into mathematical concepts faces a complex task if both representational systems are used. The student needs to understand that the use of the blocks is analogical, that the task is not simply to use the blocks but to use them to understand the symbol system. Further, the student needs to realize that some explicit parts of each "world" connect; this is representational knowledge. Finally, he or she needs to know that results in each world need to correspond in their outcomes - the "answers" should be the same. This is what is meant by action and epistemic knowledge.

For each new learning situation, the student may have one or more of these pieces in place. The teacher needs to know not just how much is in place but in what configuration. Under traditional conceptions of teaching, gaining this knowledge for every student would be difficult, even impossible. However, as is discussed in the next section, there are some proposed alternatives.

The task for students is to continuously connect their own prior knowledge with new information. A teacher may easily, and a textbook by necessity does, enter a topic in a place that is somewhere in the middle of the student's existing knowledge, which may be robust and correct, or robust and quite incorrect (much of the naive physics knowledge is of this type). More often, however, in fields such as biology or even history, the knowledge is vague and ill-formed. In still other cases, such as mathematics, the right knowledge is only partly defined so that the right sets of actions (for example, adding) or fundamental conceptions (whole numbers) are used in the wrong situation (adding fractions).

Prior knowledge about a topic has a major impact on what a student learns from a particular instructional exchange. The question for teachers is what to do about it. They can ignore prior information and build a new set of knowledge, parts of which might be expected to overlap with previous knowledge. The difficulty here is that deep misconceptions may seriously

hamper future knowledge growth or application of knowledge. Alternatively, teachers can help students build up from existing knowledge, making explicit their own prior knowledge and then incrementing it. Teachers can help students actively confront their own beliefs and revise them, for example, through class discussion. The disadvantage is that there may be socially negative consequences if the confrontation becomes personal. Magdelene Lampert, among others, shows how to prevent this by capitalizing on the energy and creativity among students, letting them, under stringent social rules, pose and refute ideas in a social arena.

Social and Cultural Roles

The discussion about multiple types of knowledge and the role of prior knowledge in learning leads to consideration of the social nature of learning and teaching. Of all the "new" ideas, this is probably the most radical. It is a dramatic departure from the approaches that grew out of behaviourism and its emphasis on individualization. Recognizing that knowledge is, to a large extent, both individual and community property suggests that attention be given to both a student's own individual growth of knowledge and the growth of shared knowledge. Public and shared definitions of problems, tasks, and solutions have a number of potential advantages.

Of all the "new" ideas, the social nature of learning and teaching is probably the most radical.

Many modern researchers share several core assumptions about learning. First, learning is an active process of knowledge construction and sense-making by the student. Second, knowledge is a cultural artifact of human beings; we produce it, share it, and transform it as individuals and as groups. Third, knowledge is distributed among members of a group, and this distributed knowledge is greater than the knowledge possessed by any single member.

One pedagogical problem is how to use knowledge of facts, principles, actions, and representations that is available within the group - or the classroom - to help individuals and groups gain more knowledge.

Proposed solutions include an emphasis on "authentic" tasks. A task can be authentic because it is part of the world outside of school (for example, a grocery store) or because it is a part of the culture of a particular discipline (such as mathematics or chemistry).

Another view on this, though, is to consider a school as having its own social system with its own artifacts and sense of authenticity. In such a culture of ideas and meanings, thought and reasoning are valued for themselves, not only for what they can do in the "real world". Both conceptions, however, suggest powerful changes in the dynamics of classrooms, changes that lead to learning.

In classrooms that recognize their inherently social nature, talk, public reasoning, shared problem solving, and shared projects all play a vital role. For example, in a class trying to understand the Declaration of Independence, the words must be read and re-read, aloud, in order to discover the meaning of the political concepts and to decipher the meaning of words as they were used in Colonial times. Phrases and sentences have to be discussed and debated. Reflections on the background of the authors, their social settings, and their assumptions have to be made. Prior actions and meetings of the men who wrote the document could

By building upon the social nature of learning, we may be able to solve some of the problems of mechanistic and fragile knowledge that seem to have plagued the American educational system.

be discussed. Far more depth could be gained from this shared experience than would be possible if each student were required to read all of the background material.

In this kind of classroom, the role of the teacher is that of a highly knowledgeable member of the community - a guide, not simply an interactive textbook. Teachers and students together track the progress of the group's understanding (metaknowledge); accept or refute the proposed interpretations of others (background factual knowledge); propose interpretations of their own (reasoning); and both increase the demand of the task and reduce its difficulty by sharing it.

Using the classroom as a social arena for the public examination of ideas does three important things. First, students gradually gain competence in using terminology and in generating actions within a discipline - in this case, interpreting a historical document (thus rehearsing the facts, actions and competencies of a discipline). Second, in the course of dialogue, students naturally build on or refute old ideas as they are merged with new knowledge (thus activating and using prior knowledge). Third, and most important, actions of discussion, proof, and explanation are merged with the network of concepts and principles that are a part of a particular subject matter. Thus, inert, isolated information is transformed into more generative, usable knowledge.

There Really Are Some Changes

Notable progress has occurred in the research on learning. I have focused here on three ideas that have consequences for teaching. First, the recognition that there are multiple kinds of knowledge suggests that neither teaching simple hierarchies of actions nor simply having students work with hands-on materials in an unfocused way will result in the deep, conceptual kind of learning that we hope students gain.

Second, the recognition that students bring prior knowledge to new learning suggests that teachers need to make this knowledge explicit, then build upon it or, if necessary, challenge it.

The third idea is the social nature of knowledge and learning. When students talk to each other, they rehearse the terminology, notational systems, and manner of reasoning in a particular domain, thus reducing the individual burden of complete mastery of material while keeping the vision of the entire task in view. By building upon the social nature of learning, we may be able to solve some of the problems of mechanistic and fragile knowledge that seem to have plagued the American educational system.

These three constructs have important implications for transforming the way teaching and learning occur in our classrooms.

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Author's note: Preparation of this manuscript was supported by a grant from the U.S. Department of Education, Office of Educational Research and Improvement (OERI), Learning Research and Development Center, University of Pittsburgh. The opinions expressed do not necessarily reflect the position or policy of OERI, and no official endorsement should be inferred.

I wish to thank Stellan Ohlsson, Micki Chi, Leona Schauble, Jim Voss, and Madeleine Gregg for their very helpful comments during the preparation of the manuscript, and Joyce Fienberg, Judith McQuiade, and Catherine Stainton for their editorial assistance.

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MICHAEL PRESSLEY AND KAREN R HARRIS

What We Really Know about Strategy Instruction

Powerful strategies for improving students' learning are available to teachers, but the conventional wisdom about which ones are effective is not always supported by research.

On a Monday morning last spring, a 2nd grade teacher taught a class of bright underachievers at Benchmark School near Philadephia how to summarize an excerpt from their social studies text. This teacher believed his students' comprehension would be improved if they could sum up what they had been reading. That same morning, a 1st grade teacher in Madison, Wisconsin, taught her class to subtract by counting down from the larger number to the smaller. She felt this strategy would improve her pupils' understanding of subtraction. Later in the day, a group of 3rd grade students in East Lansing, Michigan, watched their teacher "think aloud" as he read a story to the class, when he did not understand the text, he reread it, looking for clues to its meaning.

All these teachers were teaching *strategies*: procedures for accomplishing academic tasks. Strategies can enhance student performance in reading, composing, computation, and problem solving.

We realize now that many students do not learn strategies automatically. This assertion may be startling, especially to those who know the "classic" literature on children's use of simple memory strategies. For instance, preschool children typically do not rehearse when asked to learn lists of items (e.g. *apple, car, dog, grass, bottle*) - that is, they do not say the words over and over in order. In contrast, 11 and 12-year-olds do. Thus, many commentators have concluded that autonomous use of strategies develops between 4 and 12 years of age. But even in adults, the development of some strategies is observed infrequently, for example, the use of self-questioning to learn facts (Pressley et al. 1988b). So we've found that our earlier assumptions were not accurate.

And we've also learned a partial explanation for the dearth of strategy use: many people do not know strategies because their teachers, unlike those in the opening paragraph, don't teach them in school. Researchers find little strategy instruction in classrooms (see Pressley et al. 1989a). Information about strategies is rarely included in textbooks either, despite the growing database on strategies applicable to school tasks.

The Status of Strategy Instruction

Is cognitive strategy instruction

We realize now that many students do not learn strategies automatically.

really developed well enough to distribute to schools? The answer is complicated. Some school tasks and academic strategies have been studied much more thoroughly than others. On one end of the continuum is reading comprehension, which has been the concern of many reading researchers and educational psychologists. Quite a few reading comprehension strategies have been evaluated in true experiments, and about half a dozen have been found to improve memory and comprehension, at least for some children. These include summarization, imagery, story grammar, prior knowledge activation, self-questioning, and question-answering strategies (Pressley et al. 1989b) (see fig. 1).

Today's researchers are energetically investigating the matter of essay-construction strategies, aimed at affecting the entire planning, translating, and revising cycle that constitutes skilled writing (Harris et al. in press a). Englert, Raphael, and their colleagues at Michigan State are completing the evaluation of a strategy-instructional package that fosters the development of mature composition skills in elementary school children. Karen Harris, Steve Graham, and their associates at the University of Maryland have validated both a self-instructional strategy training approach and a set of strategies that promote effective writing (cf., Harris and Graham 1985; Graham and Harris 1989a, 1989b). For example, Graham and his associates (1989) produced striking improvements in the compositions of 11- to 13-year-old learning-disabled students. They taught these children a particular method of setting writing goals, generating and organizing notes in anticipation of writing, continued planning as writing proceeds, and evaluation of goal attainment.

So, some powerful strategies appropriate to particular academic goals and populations have been developed. However, *much* more research is required before a full panorama of well-validated strategies will be available.

Although this may come as a surprise to teachers, many strategies endorsed by curriculum and instruction publications represent only conventional wisdom about the nature of teaching and learning and have never demonstrated their worth in objective experimental evaluations. Take, for example, the presumed benefits of semantic-context strategies for acquisition of vocabulary-definition associations. Teachers are typically advised to teach students to use new words in context, that is, to construct meaningful sentences containing new vocabulary, to generate synonyms, or to practice semantic mapping of a word, including specification of related terms and opposites. These methods of vocabulary acquisition share one problem, however: They do not work. Quite a few experiments conducted during the last 15 years compared these methods to that of simply giving students words and their meanings to study. None of the semantic-context procedures produced better learning of vocabulary-meaning associations than the no-strategy control procedures (see Pressley et al. 1987). Many strategies that have traditionally been recommended simply lack research support.

Quite a few reading comprehension strategies have been evaluated in true experiments, and about half a dozen have been found to improve memory and comprehension, at least for some children.

Fig. 1 Tried and True Reading Comprehension Strategies

The following half-dozen strategies have been found to improve children's memory and comprehension:

Summarization: Creating a representation of gist.

Imagery: Constructing an internal visual representation of text content.

Story grammar: Identifying the setting, problem, goal, action, and outcome in a narrative.

Prior knowledge activation: Relating what one already knows to the content of text.

Self-questioning: Generating questions that integrate across different parts of a text.

Question-answering: Teaching students to analyze questions as a part of trying to respond to them.

Method of Teaching Strategies

It is very difficult, based on the available research, to make definitive statements about how to teach strategies, but some guidelines can be stated. Ideally, most researchers agree, cognitive strategies should be taught in conjunction with content and in response to learner needs and capabilities [1]. Thus, before they begin strategy instruction, teachers should take affective, behavioral, and cogni-

Strategic Reading

In *Strategic Teaching and Learning: Cognitive Instruction in the Content Areas*, Beau Fly Jones and her colleagues seek to apply knowledge of the learning process to methods of instruction in all content areas, to benefit both high- and low-achieving students. Their approach, strategic teaching, focuses on the role of the teacher as a model and a mediator and recognizes the dual agenda of teaching both content and strategies.

Part I of the book describes the framework of strategic teaching and the editors' working conclusions about learning and instruction. Part II tests this application of strategic teaching in science, social studies, mathematics, and literature.

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tive assessments of learners as they attempt the target task (Harris 1982, Harris et al. in press, Graham and Harris 1989b, Wang and Palincsar 1989). Once a task-appropriate strategy that matches a student's abilities has been selected, the teacher and the student should establish the potential benefits of that strategy, the goals of strategy instruction, and how and when to use the strategy (e.g. Brown et al. 1981, Pressley et al. 1984b, 1985).

Teaching modeling and self-regulated use of the procedure lie at the heart of good instruction. The teacher demonstrates the use of the strategy in the context of meaningful academic tasks and introduces strategies one or a very few at a time (that is, teaches one or two strategies over the course of several weeks or months). At first students may not "get it," at least not completely, but they will be able to start trying the procedure. The teacher guides their initial attempts, providing many prompts at this point about what to do and when to do it and tailoring feedback and re-explanations of the strategies to individual student needs.

Gradually the teacher transfers control of strategy performance to the student; the student assumes responsibility for recruiting, applying, monitoring, and evaluating the strategy over a number of sessions, with the teacher ready to intervene with additional instruction if difficulties arise. Throughout the instructional sequence, the teacher fades input at a pace permitting competent performance by the student. Strategy instruction is "scaffolded" (Wood et al. 1976), to use a term that is popular today. Student progression is criterion-based rather than time-based (Graham and Harris 1989a), with teaching and interactive practice continuing until the student understands the strategy and can carry it out.

Good strategy instruction is interactive: students should collaborate in determining the goals of instruction as well as in the implementation, evaluation, and modification of the strategy and strategy acquisition procedures (Harris and Pressley in press). In short, the teacher helps students to understand what they are learning and why they are learning it.

Teaching for Transfer

Once a student can carry out a strategy independently with instructional tasks, the challenge is to teach him or her to use the technique consistently for appropriate tasks. One way to do this is to have students apply strategies across the curriculum. Thus, the students can use variations of summarization strategies taught in reading lessons to increase comprehension and recall of science and social studies text; similarly, students can apply planning-translation-revision writing strategies (like the one being investigated by Graham and Harris 1989a, 1989b; Graham et al. 1989) whenever they are required to write a multiple-paragraph essay.

Throughout instruction, students need to see evidence that the strategies they are learning really do lead to improved performance. Nothing motivates students to use a strategy like seeing that the strategy increases competent completion of an important task (Pressley et al. 1984a, 1984c, 1988a).

But simply being motivated to use a strategy is not enough. Students must learn where and when a strategy can be deployed profitably (e.g., O'-Sullivan and Pressley 1984). Such information can often be provided by teachers or peers, although students sometimes discover this type of metacognitive information about strategies on their own (Pressley et al. 1984b, 1985). Teachers should do everything possible to encourage the development of this knowledge. They can prompt students to apply strategies or provide assistance to students in adjusting the strategy. Use of the strategy throughout the school day and across the curriculum can be encouraged by cueing strategy use, by re-explaining strategic techniques, and through additional teacher modeling of strategy use, in other words, by "coaching" (Schon 1987).

What's Next?

Although we have learned a great deal about how to teach strategies, we are on the verge of new discoveries. Teachers like the ones we mentioned in Pennsylvania, Wisconsin, and Michigan are providing new information about which strategies are really useful to students, how students master particular strategies, and how misunderstandings can be corrected when they occur. Many more specific recommendations will follow as research on strategies proceeds.[2] But we know enough now to begin to offer students these profitable and helpful avenues to learning.

Notes

[1]A set of procedures, components, and characteristics common to effective strategy instruction can be seen in the work of such researchers as Donald Deshler, Jean Schumaker, and their associates at the University of Kansas; Laura Roehler, Gerald Duffy, and their colleagues at Michigan State University; Karen Harris, Steve Graham, and their coworkers at the University of Maryland; Michael Pressley at the University of Maryland; John Borkowski of Notre Dame; and Wolfgang Schnedier at the Max Planck Institute.

[2]See Pressley et al. (in press) for an example of such research as well as further discussion about how such inquiries can affect future instruction.

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Developing Fluency through Freewriting

Getting students to begin writing and then keeping up the flow are challenges in English language classrooms. This scenario is familiar: The teacher assigns a writing task, students fumble for their writing paraphernalia, sit and stare at stark, blank sheets of paper, agonize about what should go on them. After moments that seem like ages, some words and sentences appear. Students read the sentences to make sure that the grammar is correct, that the words do not betray their ignorance of spelling, and that things sound right. Some tear up their paper or roll it into a ball and start all over, not once, but twice, even thrice. They plod on, painstakingly, until a sensible number of pages are filled up. Some only have the bare minimum by the end of class.

Why do students find writing a laborious task? Why is it so difficult for many to write at length in continuous prose, allowing ideas to flow in abundance as they write? Is there something that can be done to help develop ease and fluency in writing? Research has some answers to the first two questions. Strategies used by classroom teachers, in concert with ideas proposed by introspective research, have some answers to the third. Knowing some underlying reasons for temporary writer's block and developing strategies to help nurture fluency in writing are steps to successful teaching of writing. This paper first examines some theoretical perspectives and then discusses approaches that have been found effective in fostering fluency in writing.

Why Writer's Block?

Research has shown that two underlying factors contribute to temporary writer's block and tension during writing. When writers are overly conscious or critical about the writing and attempt to edit even while producing, they are putting barriers in the way of idea development. When writers are unfamiliar with the content of a piece of writing, or are uneasy or apprehensive about putting personal thoughts and feelings on paper, they are bound to find difficulty in letting ideas flow in abundance.

Elbow (1973) points out that editing to address mistakes, awkwardness, wordiness, and inappropriate ideas and expressions is, in itself, not a problem. Editing is usually necessary to produce something that is finally satisfactory. "The problem is that editing goes on at the same time as producing" (p. 5). Flowers (1981, p. 835) vividly describes the opposing forces of producer and editor working simultaneously to block the free flow of ideas. She calls the former "madman," and the latter "judge." Even while the madman is "full of ideas, writes crazily and perhaps rather sloppily," the judge is constantly peering over the madman's shoulders, criticizing and pointing out errors and shortcomings. "So you're stuck. Every time your madman starts to write, your judge pounces on him," arresting the flow of creative energies and ideas. "No wonder the producer gets jumpy, inhibited, and finally can't be coherent" (Elbow, 1973).

Idea development can be inhibited or even arrested when writers are not personally involved in a piece of writing for various reasons: When they do not know the content well enough, when they are not interested in the content, when they do not feel ownership for the writing, or when they feel threatened about having their innermost thoughts and feelings exposed in writing. Murray (1985) points out that the common classroom practice of assigning topics or subjects for writing is especially open to all the above deterrents to fluency. Students are often required to write on topics chosen by someone else, topics that may have nothing to do with their interests or experience. Murray suggests that to reduce apprehension about writing and thereby, enhance fluency, students need to surmount the first hurdle by experiencing success through writing about things that matter to them, things that they know well or have experienced and feel ownership for. It is only after this initial hurdle has been surmounted that they can proceed to write on other topics, first on ones that they are not clear about so that they can go through processes of developing ideas, clarifying them, and communicating them unambiguously to others. From then on, students can write on increasingly objective topics, using these processes in a variety of writing tasks, academic and professional (Murray, p. 240).

Teachers who are cognizant of the primary causes of temporary writers' block can do much to help students develop fluency in writing. The following section discusses freewriting

from theoretical and practical perspectives, and its role in fostering fluency and enjoyment in writing.

Freewrite for Fluency

Freewriting is a process that has been found to be effective for overcoming the two main deterrents to fluency - overconcern with correctness and accuracy, and apprehension produced by unfamiliarity with, or lack of interest in, the content of writing. In freewriting, both these deterrents are removed to free the writer from the constraints that shackle idea production. Three variations of freewriting are discussed below: The first by Peter Elbow (1973), one of the earliest proponents of freewriting, the second by Maria Hoffman, a teacher who succeeded in getting students with learning difficulties to write copiously and enjoy writing, and the third by myself, when I designed and implemented a freewriting program for secondary school students of mixed ability and cultural heritage in the United States.

The basic premises and practices of freewriting are described by Elbow (1973). In freewriting, students have to write on call, consistently and continuously, at regular intervals, and within a specific amount of time set aside for the freewriting session. Elbow suggests that ten minutes be allotted for freewriting three times a week for a start (fifteen to twenty minutes in later stages). During the whole of the ten minutes, students write at a brisk but unrushed pace, non-stop: "Don't stop for anything. Go quickly without rushing. Never stop to look back, to cross something out, to wonder how to spell something, to wonder what thought or word to use, or to think about what you are doing." The crucial thing is to write, to keep the pens or pencils moving. If the writer is short of ideas or is unsure about a spelling or a word, he/she keeps writing, using fillers: "Use a squiggle or else write, 'I can't think of it.' Just put down something. The easiest thing is just to put down whatever is in your mind. If you get stuck it's fine to write 'I can't think what to say, I can't think what to say' as many times as you want; or repeat the last word you wrote over and over again; or anything else. The only requirement is that you **never** stop" (Elbow 1973, p. 3).

In Elbow's approach, freewriting is never evaluated. Writers need to be able to write with facility, to be released from apprehension brought about by overly concern with evaluation and judgement. This frees writers from the conflicting concerns of creator and judge, producer and editor. In freewriting, the creator and producer are in the foreground, relegating the judge and editor to a role in the background. Writers are thus, during the time they are freewriting, able to focus only on expressing ideas, thoughts, and feelings, never needing to stop for grammar, spelling, vocabulary, and correctness.

In freewriting, writers have complete ownership and control over the product of their writings. Elbow suggests that these writings should not be discussed or commented upon unless writers agree to it. Teachers can invite writers to let them read the writings but writers have the option to keep their writings to themselves if they choose to.

Maria Hoffman (unpublished paper) adapted Elbow's approach in a freewriting program that she used with twenty-three secondary students with learning disabilities in the United States. Before the program, which lasted for 3 1/2 months, her students had severe problems with fluency and content development: "Writing was a heavy burden to endure, and some would take the route of refusing to write." Hoffman's approach was similar to Elbow's in principle. She, however, adapted it to the classroom by adding more interactive activities between teacher and students and among the students themselves. For each ten-minute session, students were instructed to write anything that came to their minds, and as thoughts ran through their minds, they would write them down and expand on them. When they had a temporary blockage, they would write the last sentence on the page several times until another idea came, or they could describe what was going on around them. The teacher wrote together with the students in a warm, non-threatening atmosphere.

Sharing sessions were conducted after freewriting, a variation from Elbow's approach. Students shared most of their writings, but they could decline once in a while if their writings were too personal. Sharing sessions were done on a whole class basis or in groups. The teacher was a full participant, sharing her writings with the students. The objectives were to have audience response to writings and for writers to discover the effect of their writings on others. During these sessions, students read their writings. The other students would then react to the writings. The teacher first modelled appropriate responses. The students then talked about what the writings triggered in their minds, what they thought about as the writers read the writings, what images the writings conjured in their minds, and what they liked about the writings. The writings were not evaluated, as Elbow suggested. To ensure accountability, however, Hoffman assigned participation grades that were based on how well the students participated in the writing and the sharing sessions. This measure was a compromise between allowing absolute ownership with minimal need for accountability that freewriting, in principle, endorses, and the need for a degree of accountability and structure that school requires.

Hoffman reported very positive results from freewriting. On completion of the program, most of the students had no difficulty getting started and generating content whenever writing assignments for English were given, a vast contrast from before the freewriting experience. Their writings had also become more fluent, with more interesting and longer pieces. Hoffman suggested that this

could be due to the discussion groups - having audience response might have motivated the production of more interesting writings. The students' attitude to writing was dramatically changed. They now chose to write when they were not required to do so, asking their teacher whenever an opportunity presented itself to let them write. Both student and teacher now looked forward to writing as a pleasurable experience and as a means to express their feelings and record their thoughts. Both had learned appreciation for one another.

The freewriting program that I implemented was also based on Elbow's principles, with modifications made to meet the specific needs of the student population and the school. The modifications were made to give the program more structure and the students more guidance, and to satisfy the need for accountability and assigning credit (or grades) for work done in class.

Seventy five high school students from three English classes were involved in the program. There was an average of 25 students in each class. They were fourteen- and fifteen-year-olds from a high school in Virginia, U.S.A. Sixty percent of the students were Caucasian Americans, 20% Black Americans, 14% Asians (Chinese, Koreans, and Vietnamese), and 6% Hispanics. The students were assigned to three English classes that used an integrated, process-driven approach to literature and language learning. They were heterogeneous in ability and language proficiency, with about 5% of high ability ("A" students), 15% of above average ability ("B" students), 50% of average ability ("C" students), and 30% of below average ability ("D" and "F" students).

At the beginning of the project, the writing ability of the students generally varied according to their overall ability in English. The above average and high ability students were good writers, able to produce copious and interesting writings within short periods of time. The students of average ability varied in their writing ability. Some could produce fairly interesting writings that were generally shorter and less complex than those of the high ability group, while others had difficulty producing even short pieces. This group, generally, were slow in getting started on writings. Many regarded it as a chore and needed considerable amount of guidance and monitoring before they could produce acceptable writings. The below average students had the most difficulties in writing. Most regarded it as a burden. Some tried to write but could manage only very short, sketchy writings of three to five sentences at twenty minute sittings. Some flatly refused to write. Some of these students had learning disabilities and also attended "resource" classes where they were given individual attention by resource teachers.

The writing project began in October, 1991, and ended in March, 1992. A total of fifteen weeks were taken for freewriting. The students wrote three times a week for ten minutes each time at the beginning of a period. They each had an exercise book specifically for the purpose of freewriting. These exercise books were distributed and ready for them as soon as they entered the class and were collected back and stored in the class for the next freewriting session. The students wrote for exactly ten minutes each time. They were instructed to write non-stop for the whole of the ten minutes on topics of their own choice or others from a list of more than 120 topics that were generated by the class (details of how the class-generated topics were compiled will be discussed later). They could write in any genre - prose, poetry, or drama. During the initial stages of the program, I explained the reasons for engaging in freewriting and gave the following instructions prior to the commencement of each writing session: "Let your ideas flow, don't stop to reread, keep your pen moving, don't worry about the paragraphs and spelling and grammar, repeat your words or record what you see going on around you when you are stuck - most important - keep your pen moving and keep writing." These instructions were repeated for a few sessions until the students were observed to use the strategies voluntarily. The students were encouraged to aim for a minimum of one page at each ten-minute sitting and to go beyond the minimum if they completed one page before time was called to stop writing. During the sessions, I modelled freewriting by writing together with them.

The issue of content or what to write about was addressed at the beginning of the writing project. The class got together in a collaborative effort to compile lists of topics that they were interested in, that were relevant to their lives, and that they had experienced. To facilitate the discussion and to help students focus on relevant ideas, I gave them lists of questions for discussion that centered around themselves and their experiences, questions such as: What do I know really well? What do I do really well? What are the things that are most interesting to me? What would I like to do? What are my funniest (or happiest, saddest, most unforgettable) experiences? Who do I like (or not like) to know? What bothers me most in people? Who are the people I would like most to meet? After discussing these questions, each student contributed a topic by turn until everyone had made one contribution. The initial round generated 25 topics from each class, making a total of 65 topics (less the ones that were not suitable). Topic generation as a class was repeated a week later, generating another 60 topics. Examples of the student-generated topics included: "Losing your best guy friend to your best girl friend," "Why I love to eat junk food," "How much I want to meet ---," "Feelings about ---," "What I would like to do in the near (and distant) future," "A messed-up haircut," "Surprise!" "If I were ---," "Stress," "Why people use drugs," ""Homework blues," "How I feel today," "Favorite song (or movie, or T.V. program)," "Weekend

without parents," "Fads," "Feeling scared." A class secretary recorded down these topics, typed them, and distributed them to the students who kept the list in their freewriting exercise books for easy reference whenever they needed topics to write about or were short of ideas. Fresh topics were compiled four weeks later. This time around, the students referred to the writings that they had already done, and chose topics that had not been included in the first round. An additional 80 topics were generated in this way. The students were encouraged to use the class-generated lists when they ran short of ideas for writing.

The exercise books were collected every four weeks so that credit could be assigned and for the teacher to respond to the writings. The scheduled dates for each collection were communicated to the students at the beginning of the program. They were assured then and at each collection that points (marks) would be assigned only for the quantity of writing that they had produced and not for the "quality." All their writings were confidential. If there were writings that they did not want the teacher to read for any reason, they could indicate it on the writings or even fold certain pages together. Five points were given for each complete page of writing, with absolutely no evaluative comments on errors and inaccuracies. Green ink or a pencil was used for making positive remarks or to write a response when the writers solicited a reply from the teacher to certain problems or issues. Red ink was not used because of its association with critical evaluation.

Very positive results were observed at the end of the program. Most of the students now had no difficulty getting started when they wrote English assignments. They could sustain interest in writing for longer durations. They were also producing longer writings that flowed more easily and naturally, with richer content. Some students were even beginning to develop a distinct personal writer's voice.

Freewriting had also helped the students to overcome inhibitions about putting their feelings and thoughts into writing. There were many extremely personal outpourings in the writings. The students had learned to use writing as a way to deal with problems, to use it as a safety valve for intense emotional experiences.

Several outstanding writings emerged from the project. Four students wrote short stories, each story spanning several sessions of freewriting. Two students embarked voluntarily on mini-novels with elaborate plots and character portrayal. By the end of the project, their novels took up more than half of their exercise books and they were still writing. One finished his novel at home and was considering finding a publisher for it. We also discovered two very good poets through freewriting. One was an Asian student who had learned English as a Second Language before joining mainstream classes. The other a Caucasian girl who gave no indication at all that she was a poet. Both had been considered average English students.

Discussion

The benefits of freewriting are many, as Hoffman and my own experience had shown. Students do need to be afforded an opportunity to freewrite, to be able to express their thoughts and personal feelings and reactions without being worried about being judged. This is an end in itself. Freewriting helps students feel good about themselves and their writing. By giving them choice and ownership, they can see themselves as independent writers and not merely as students whose writings have to be subjected to the close scrutiny of a teacher or an evaluator. Freewriting addresses the needs of students of all ability levels. The more proficient ones can aspire to as high a level of writing as they want without being slowed down by less proficient ones. For the latter, there is usually a sense of achievement in being able to accomplish something in ten minutes. Freewriting is also a means to an end. By developing fluency, students' writings on academic and objective topics will improve in both quantity and quality. When students write academically demanding pieces, freewriting should be the first step in composing. Letting ideas flow in abundance without undue concern for correctness in structure and mechanics in a first draft should usually be attempted. The next step is revising and editing the idea rich draft to make it more satisfactory. Only when ideas have been developed and when the producer and creator have done their part should the critique and judge intervene. To play both roles simultaneously is to be counteractive. Freewriting helps writers sort out the conflicting roles that stand in the way of fluency in writing.

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RUTH WONG YEANG LAM

"I am not clever enough": Singapore students constructing meaning in English and Chinese

The winds of change in language studies: From product to process

As interest in second language acquisition grows, and more and more studies are conducted in this field (McLaughlin, 1987; Krashen, 1985, 1982; Wode, 1983, 1981; Long, 1981), it becomes clear that in order to make more accurate statements about how a second language is learned, a good deal has to be known about the second language learner. Reid & Hresko (1981) stress that

> ... it is important to consider what happens internally to a person who is learning and to view learning as construction. It is the learner who is the most important element in the teaching-learning situation; not materials, lessons, teachers, or other factors external to the learner.
>
> (p. 49)

This shift from the product to the process places importance on the *active* learning on the part of the learner, that is, the *strategies* used in the learning process.

The study

A study was conducted to examine the strategies that Secondary 3 students in Singapore use while constructing meaning in English and Chinese.

Out of a sample of 198 Secondary 3 students from four Singapore schools, a sub-sample of 43 students was randomly selected and categorized into four groups as follows:

A Those proficient in both languages (n = 10)
B Those proficient in English but weak in Chinese (n = 12)
C Those weak in both languages (n = 11)
D Those proficient in Chinese but weak in English (n = 10)

This sub-sample was asked to write an expository composition in both English and Chinese, and to think aloud as they wrote. They were also interviewed on their strategies for learning the two languages. This paper documents the findings of this interview.

Findings

Group A: Those proficient in both languages

The students in this group express the importance of an early and solid foundation for effective language learning. They exhibit a sophisticated awareness of the use of learning strategies, which they are able to articulate and spell out. Some strategies that are used by the students in this group when writing in English include re-reading; using phrases picked up from books; using short, powerful sentences; and calling on prior knowledge. For the construction of meaning in Chinese, students cite strategies such as memorization; thinking of some idioms or phrases; and recalling scenes from the television. Though they are proficient in both languages, they admit that writing Chinese characters is a problem. There seems to be a concern to expand their lexical choice because they are of the opinion that "hard words" (Student 097) can impress their reader, and they want to "create an impression". One student advises, "Use some difficult words or proverbs to show that you have a higher standard in the language and that you can express yourself better." Those who are native speakers of the language (be it English or Chinese) tend to go by sound to check for correctness. In addition to the above strategies, this group also stresses that attitude plays a crucial role in language learning.

Group B: Those proficient in English but weak in Chinese

The students in this group are also able to articulate their strategies. They see the importance of planning and having an overall goal; once that is available to them, their writing flows smoothly. Like the students in Group A, the students in this group also use the strategies of re-reading and using phrases borrowed from other authors when they construct meaning in English. For most of them, vocabulary for both languages, but especially for Chinese, their weaker language, seems to be the over-riding concern. One student states categorically that he sometimes uses English, his stronger language, to help him in his Chinese. The students in this group, though they are prolific readers of English novels, explain that they read very few Chinese novels because the content is not interesting and the language is too difficult for them[1]. Two students mention that they have a negative attitude towards Chinese, and that they are aware that this therefore adversely affected their learning of that language.

Group C: Those weak in both languages

In stark contrast, the students in this group seem to be a discouraged lot who claim they have no strategies; do not know of any; do not know how to use any; forget to use strategies; or "are not clever enough" (Student 203) to use any. Practically all of them manifest a sense of learned helplessness as language learners (used to be "too playful and did not pay attention"; "do not read because do not recognize the words"; "too late to try now"; "now try to like reading but discouraged by results"). The analysis of their think-aloud protocols indicate that this group is not totally lacking in strategies. It therefore appears that the students in this group do not possess the metacognitive awareness of the strategies they are using. Nor do they possess the know-how on how to use strategies effectively. Those who do make use of strategies use those advised by their teacher, for example, the use of flashback.

Group D: Those proficient in Chinese but weak in English

What is striking about the students in this group is their concerted effort to want to help themselves in language learning. Most of them try to read to improve their proficiency in the two languages ("read repeatedly, then write"; "reading is important for improvement"). This group, more than any of the other three groups, appears to read more in Chinese. This could be due to a combination of factors. Perhaps the students in this group genuinely want to help themselves. Also, it is not so discouraging for them because they are more competent (and therefore experience less difficulty) in reading and comprehending Chinese reading materials. In addition, many of them are able to articulate some of the strategies they employ (for example, "get phrases from books"; "recall other author's style"; "watch television"; "memorize"; "try to remember words used"; "write draft first"; "write several times"). One student even offers the insight that "strategy can be taught, but memorization cannot be taught". This seems to be the general myth

Under Singapore's education system, where English and Chinese are explicitly taught and consciously learnt, students must be able to see both the delight and the usefulness of these two languages.

surrounding the students - that memorization (which is synonymous with the learning of the Chinese language) is equated with sheer meaningless memory work (Wong, 1993). It is also striking that this group stresses oral proficiency as an aid to writing proficiency ("speak more Chinese in order to improve writing"; "would like more opportunity to speak English").

Implications for teaching

Under Singapore's education system, where English and Chinese are explicitly taught and consciously learnt, students must be able to see both the delight and the usefulness of these two languages. Our role as educators is to select and organize worthwhile experiences for our students. We want our students to be active agents empowered to orchestrate knowledge, to be capable of having their own thoughts and be armed with the strategies to construct meaning from these thoughts.

Equipping students with strategies enables them to take a more self-directive role in their mental development, and increases their level of awareness of the processes they are using. Holt (1964) states:

> Part of being a good student is learning to be aware of one's own mind and the degree of one's own understanding. The good student may be one who often says that he does not understand, simply because he keeps a constant check on this understanding. The poor student who does not, so to speak, watch himself trying to understand, does not know most of the time whether he understands or not. Thus, the problem is not to get students to ask us what they don't know; the problem is to make them aware of the difference between what they know and what they don't.
> (p. 28 - 29)

In the light of the findings of this study, it is all the more crucial that we help learners such as those in Group C. We could start by raising their metacognitive awareness of strategies used for meaning construction when writing in two languages. The strategies that they are already using but are unaware of could be strengthened and enhanced. What is even more urgent is the need for us to help them break out of their learned helplessness, to convince them that strategies can be learnt and taught, and that no one is "not clever enough" to use strategies for meaning construction.

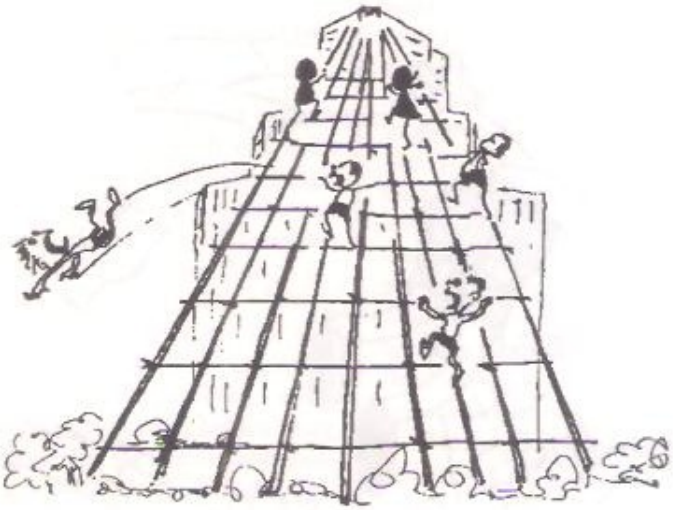
Strategies, strategies!

Thus, we have an important role to play in both representing new ideas to ourselves, and rendering these ideas accessible to others. In Shulman's (1991) words:

> The teacher must invest his/her energy in the learning of others. This is an act of great investment, both of energy and faith. Without a moral commitment to tbe belief that all human beings are born with the capacity to know, teachers will begin to invest their pedagogical energies only in those whom they deem likely to succeed. In that prediction lies the seeds of a self-fulfilling prophesy that can poison the fertile ground of educational practice.
> (p. 18)

It is time to adopt a pedagogy that recognizes who our students are. Holzman (1986) argues that without taking into account who our students are and what their lives are like, we cannot hope to bring about the kinds of changes in the classroom that are necessary in order for our students to become literate. Likewise, Zamel (1987) points out that the pedagogy we adopt should begin with an attempt to understand individual learners and recognize that learning to write for school purposes is not just a matter of acquiring basic skills or correcting errors. It means a whole new way of knowing, a way of knowing that involves and welcomes our students as active participants in a community of writers. We must break out of the traditional mold where writing is reduced to a set of discrete steps and prescriptive principles, and provide our young charges with reasons and purposes for learning in this new way.

The teacher's role should be one of providing instructional scaffolding that will equip students for life-long learning. It is important to emphasize that good scaffolds serve to support student efforts, but are dissolved once they are no longer needed. Teachers who are truly collaborators, facilitators and enablers in every sense of the word will strive to raise their students' consciousness about strategies. They will help them to internalize the strategies, and equip them with the resources to eventually learn on their own.



Providing Instructional Scaffolding

Effective teaching of writing strategies will lead to an improvement in the quality of thinking in the formalized school setting. At a time when Singapore exhorts excellence in education, one of the "core values" of language learning must surely be a concerted efffort to equip young Singaporeans with strategies to maximize their learning potential and to make learning emergent, to develop language to enhance cognition and to empower them with critical thinking and creative adaptation for life-long learning. The simultaneous learning of English and their mother tongue should arm our students with both the language of technology and the language which makes them proud of where they come from, where they are and where they are going. They are the new generation of **creative, thinking** and **innovative** people who will lead Singapore into the 21st century.

[1]A more detailed discussion of Singapore students' lack of reading of Chinese books is reported in Wong, Yeang Lam Ruth (Forthcoming) Chinese books in our school libraries: No time to stand and stare. Asian Literacy & Reading Bulletin.

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MARY RENCK JALONGO

Teachers' Stories: Our Ways of Knowing

By sharing stories about their classroom experience, teachers not only gain insight into their own practice, but they also contribute to the storehouse of knowledge about teaching.

Consider for a moment how other professions use stories, not just as casual conversation, but as tools for professional growth. In medicine, stories are case histories; in law, stories set legal precedents; in business, real and hypothetical stories become scenarios. Experts from every walk of life organize their specialized knowledge and skill into episodes, events, or cases (Bruner 1988, Carter and Doyle 1989). Among the social sciences, education alone remains reluctant to share and value the stories that give form and meaning to our lives as educators. We need to use stories as other professional fields do, to treat stories as "little factories of understanding," using them to "attract and light up everything relevant" in our professional lives (Hughes 1988). Educators' stories about teaching and their reflections upon them are a deceptively simple way of addressing significant issues about what it means to teach and to learn (Frederick 1990, Schon 1983).

The Power of the Narrative

Our technological society's insistence on "hard data," facts, and empirical research would tend to suggest that the story is an inferior way of knowing - narratives are "soft," subjective, and ungeneralizable. But there is nothing to be gained by creating artificial dichotomies between these two very different, yet complementary, ways of knowing (Abbs 1984, Bogdan 1980, Calderhead 1987). Almost to a person, the best people in our field have learned to allow their scientific and narrative modes to interact. As Sutton-Smith (1988) points out,

> The narrative mode has little to do with objectivity, predictors, and verifications; rather, it has to do with consensual support, impartial readings, and verisimilitude. The science that derived from physics and mathematics is a science of verification; the science that derives from linguistics and narratives is a science of interpretation (pp. 22-23).

An Act of Mind

Stories are "a primary act of mind," a basic way of processing information (Hardy 1977). Both children and adults find it much easier to remember and use material presented in story format rather than as a categorized list (Bretherton 1984, Egan 1986). If you doubt this is true, attend an all-day workshop and consider what you recall in any great detail by the end of the day or much later. Chances are, it is a personal anecdote shared by a workshop leader or a participant.

It used to trouble me that whenever I encountered former students, they would invariably remark on my stories about children rather than the theories or research I was trying to convey. But now I have come around to Seymour Papert's (1990) perspective on learning:

> Understanding learning is my life-long passion ... But interestingly I find that what helps most is not the proliferation of abstract principles. I gain more by extending my collection of "learnings" - concrete learning situations that I can use as "objects to think with" (p. ix).

I now believe that the teaching stories I chose to share with students served their purpose. Those stories and our reflections upon them have been and continue to be "good things to think with."

The Story is You

Susan Ohanian (1989) once observed, "The more I teach, the more I realize that we teachers are nothing but our anecdotes, our reflections on experience." As teachers, we become the stories we choose to tell. If our personal narratives are primarily celebrations of student learning, we have high expectations for students; if the stories we choose to tell about teaching are little more than petty complaints, we have grown dull and apathetic; or, if our personal narratives are mainly tales of despair, we are "burned out" and in desperate need of renewal. This happens be-

cause personal narratives are a way of "structuring experience itself, laying down routes into memory, for not only guiding the life narrative up to the present but directing it into the future ... a life as led is inseparable from a life as told ... a life is not "how it was" but how it is interpreted, told and retold" (Bruner 1988). Stories about teaching enable us to organize, articulate, and communicate what we believe about teaching and to reveal, in narrative style, what we have become as educators.

Contributions to Professional Growth

Professional growth is more like finding our way through a forest than driving down a freeway; each of us must find our own path to professional fulfillment. Teacher stories contribute to that process of discovery.

Teachers' Stories Invite Reflection

One thing that differentiates reflective practice from routine practice is the number, richness, and flexibility of the "scripts" teachers bring to the classroom setting (Schon 1983, 1987, 1991).

As a veteran educator, I sometimes hear a veteran teacher complain that a novice teacher "just doesn't have common sense." Professional educators' common sense derives, not from rote memorization of many precise pieces of information, but from those stories used to make all those bits of information cohesive and relevant. Reflective practitioners have "common sense" precisely because they have a storehouse of stories that organize, apply, and interpret what they know about teaching (Shafer 1981). Figure 1 suggests specific strategies for using stories to encourage more reflective teaching.

Teachers' Stories Are a Metaphor for Change

Stories are not crystallized; they are fluid. As stories evolve, they sometimes seem to take on "a life of their own. New revelations of meaning

FIGURE 1

A Dozen Story Ideas*

1. Reflections on Improvement (Chism 1990)
The change I made;
What prompted the change;
The impact of that change and how I assessed it.

2. A Metaphor for Myself
What best symbolizes you as a teacher?
What are the features that unify your self and the symbol you selected?

3. At Least ...
Generate a series of statements about making the best of a bad situation in your professional life (Our district may be in a budget crunch, but at least I ...)

4. Joyful Moments
Make a list of the most joyful moments in your professional life.

5. Imaginary Dialogue
Write an imaginary dialogue between your self and the school, an administrator, a colleague, a parent, or a child.

6. Unrevealed Kindnesses
Write about a situation where you went above and beyond the call of duty to help a child in distress.

7. Remembrances
Reflect upon your own experience as a child at school. Write about an incident from your childhood that has enabled you to develop greater empathy for the children you now teach.

8. Low Points
Describe an incident that nearly caused you to abandon the teaching profession. Looking back on it, why was this such a critical incident?

9. Heights and Depths
Write about your most and/or least successful learning experiences.

10. Memorable Teachers
Profile the best and/or worst teacher you ever had.

11. Packing Decisions
If you were invited to teach overseas and knew that your teaching resources would be very limited, what would you pack in your suitcase? Compare/contrast your choices with those of other teachers. What do your choices reveal about you as a teacher?

12. Looking Back
Contact a former teacher you admired and interview him or her. What insights did you gain about the teacher? About yourself?

*Items 2-6 adapted from Cooper (1991).

Stories about teaching enable us to organize, articulate, and communicate what we believe about teaching and to reveal, in narrative style, what we have become as educators.

open out of their images and patterns continually, stirred into reach by our own growth and changing circumstances" (Hughes 1988. p. 35).

As an illustration of the dynamic quality of narratives, consider this story that Krista, a preservice teacher, shared with a class of student teachers after her initial meeting with a small group of 1st graders:

I was handing out construction paper and giving the children their choice of colour when this child shouted, "I want black. Black is superior. Black is always superior."

I thought, oh boy, I am really going to have problems with this one. I just never thought people had those racial attitudes so young.

One of the teachers in the group asked Krista if she would have made the same inferences about racial attitudes if the child had been white and had said, "I want white, white is always superior."

"Maybe not," Krista admitted, "maybe he just wants attention."

Several weeks later, Krista shared with the class a different viewpoint about this child.

Yesterday, I was teaching a lesson on the concept of celebrations. At the end, I asked the children to draw a picture and tell a story about a celebration they had experienced.

This little boy said,"No! There ain't no celebrations at my house since my baby sister died."

I found out that his sister had just died of leukemia. Next time, I won't be so quick to judge. I'll learn to focus more on the child and less on my own problems.

When I shared this story with a group of students, some were quick to judge Krista. Rose remarked,"I'll bet she felt ashamed." But when Rose had a personal experience with misinterpreting a child's behavior, she quickly recognized the similarities:

On the first day of my summer school class, Joey came into my classroom, slumped in his chair, folded his arms across his chest, and mumbled obscenities. I took him aside and he stopped cursing, but he maintained uncooperative for several days.

Later, Joey confided that he knew he was going to have "a really mean" teacher next year in 3rd grade and that he had been afraid that summer school "would be the same." Evidently, the cursing was his way of defending himself.

Rose realized that "just as in the story you told about the boy whose sister had died, I was worrying about what *I* was going to do instead of wondering *why* is this kid behaving this way?"

To see how stories become metaphors for change, notice how the same story was interpreted and reinterpreted. For Krista, what began as a "racial incident story" ended as a "becoming a more child-centered teacher story." For Rose, it was a story about a mistake she could not imagine herself committing. Yet later, she realized the issue was the same one she faced.

The same story not only encapsulates the transitions made by those directly involved but also transcends the boundaries of time and space when it is shared with others. That is because "a story is something happening to someone you have been led to care about ... whatever its subject matter, every story is about change." (Shulevitz 1985, pp. 7, 47).

Teachers' Stories Promote the Ethic of Care

Asked about their concerns as preservice teachers, one student, Teri, responded, "Maybe this sounds funny - but I worry about caring too much, about children's problems 'getting to me.'"

Teri's comments prompted me to share the following story about April, a kindergartner:

The first child I noticed in the class was April. She looked neglected and seemed desperate for approval. I had seen April's teenaged mother pick her up at school once, but April's grandparents, who were openly resentful about having to care for her, appeared to be in charge.

I was in the classroom one day as the children were getting ready to lie down on carpets for "quiet time." A classmate asked sarcastically, "Hey, April, where's your rug?" and another answered, "She probably doesn't even have one."

April responded by making a funny face and dancing around wildly. When the defensive laughter faded, April walked over to the sink and pulled out a handful of paper towels from the holder. Then she unfolded the paper towels, spread them out on the tile floor, and curled up on top of them in an awkward fetal position. I couldn't stand it. I started to cry. April's teacher seemed oblivious to this dramatic Friday afternoon

The world we know is the world we make in words, and all we have after years of work and struggle is the story

event.

That weekend, I discussed the incident with my family. Almost before the story ended, my young nieces were rummaging through the linen closet. They thrust a small carpet into my hands. "Here. Take this to school and give it to her," they said. "If you're worried that the teacher will get mad, don't let her see you."

Teri responded to this story. She told me it "really helped me to feel it's okay to be sensitive and it's reasonable to take action." The story of April was a better response to Teri's concern than any other reason I could formulate. It was better because it demonstrated the ethic of care that must dominate our profession (Noddings 1984, Witherele and Noddings 1991).

When I shared the story with experienced teachers, they spoke - many of them for the first time in their professional lives - about "unrevealed kindness," things they had done for children without any expectation of reward or recognition. To me, that ethic of care and stories about it are like the mast of a ship on a turbulent sea; we lash ourselves to it as a defense against incessant waves of change for change's sake and gales of criticism. Stories remind us of the reasons we went into teaching in the first place.

"All We Have Is The Story"

Personal narratives can reveal the nurturing dimension of the teaching role, characterize important changes in our professional lives, and encourage more reflective practice. All of these benefits have a direct impact upon professional growth because "our lives are made of stories. Such stories allow us to explore our lives, to try out alternative possible ways of acting and being in the world, and indeed to help shape our future actions" (Kazemek 1985, p. 201).

Personal narratives are not superfluous features of teachers' lives; they are basic to our professional growth. Ultimately, "The world we know is the world we make in words, and all we have after years of work and struggle is the story" (Rouse 1978, p. 187).

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ROBERT SYLWESTER AND JOO-YUN CHO

What Brain Research Says About Paying Attention

As scientists unravel the mysteries of the brain, the implications of the findings will help educators expand on what they know about how to focus students' attention on learning.

Helping students to "pay attention" has always been a central concern of educators. Attention - the ability to focus the mind - is a prerequisite to learning and a basic element in classroom motivation and management. Students who have difficulty concentrating may suffer from seriously disruptive illnesses such as attention deficit disorder and dyslexia.

Further, the design of our brain's attentional system suggests a curricular dilemma. The system evolved to quickly recognise and respond to sudden, dramatic changes that signal physical predatory danger, and to ignore or merely monitor the steady states, subtle differences, and gradual changes that don't carry a sense of immediate alarm. However, schools must now prepare students for a world in which many serious dangers are subtle and gradual; overpopulation, pollution, global warming, acid rain, for example. How do we reset a powerful cognitive system to meet new challenges?

Until recently, cognitive scientists had only a limited understanding of our brain's attentional mechanisms and processes, so educators had to rely on their own practical knowledge. That situation is changing dramatically as scientists unravel the mysteries of how our brain determines what to attend to and what to merely monitor and ignore. Educators must understand the basic mechanisms and processes that regulate attention if we ever expect to make valid and useful educational applications of this significant research development.

Attentional Processes

An effective attentional system must be able to (1) quickly identify and focus on the most important item in a complex environment; (2) sustain attention on its focus while monitoring related information and ignoring other stimuli; (3) access memories that aren't currently active, but that could be relevant to the current focus; and (4) shift attention quickly when important new information arrives.

Some stable elements in our attentional system, which develop early, automatically and predictably reduce the complexity of the surrounding sensory environment. They allow us to quickly respond to sudden threatening events. Other more adaptable elements develop later, and we can teach these adaptable elements to respond to more subtle sensory stimulation, gradual changes, and social demands, such as school procedures (Ornstein and Ehrlich 1989).

Attention generally begins as a passive process - the brief unfocused reception of the multitude of molecules and rays that continually bombard our body's specialized sensory receptors with information on the outside environment. This period of passive reception is important because it allows our brain to process as many stimuli as possible while it actively searches for anything that might require immediate attention.

But because our brain can't process all this information, stable mechanisms limit input to narrow ranges that contain the potentially most useful information. It's interesting to note that our brain's sensory range differs from those of animals that share our environment. For example, our 10-octave sound range doesn't extend to the higher pitches that dogs hear, and visible light doesn't extend into the lower infrared levels that insects see and that we experience only as heat.

Further, our stable attentional

mechanisms are primed to focus automatically on those sensory patterns within these narrow ranges that contain high contrast and/or emotional intensity. Thus, even a passive glance will pick up rapid movements and the lines that define the edges of objects, and a familiar voice will automatically bound out of the babble into our ears.

The external-internal shift. In this active search, our brain frequently shifts its focus between external events and internal memories and interests. For example, while I'm listening to a friend's story, the memory of a related personal experience may suddenly pop up in my mind. I'll usually shift my attention to my own mental story and merely monitor my friend's story while I'm processing mine.

This attentional shift between external and internal events appears to be an important element in maintaining and updating long-term memories, since it ties past experiences to the present situation. Much of our conscious activity involves the deliberate search for cultural experiences (such as TV shows, films, novels, music, trips, conversations with friends) that we know will trigger memories. The recalling and retelling of our memories strengthen the neural networks that contain and process them.

The focus and intensity of active attention can vary widely. Contrast a proofreader and a cursory reader of a magazine article. The first carefully examines individual words and punctuation; the second focuses on the general content. When we consciously seek such specific information, our attentional system primes itself in anticipation. It increases the response levels of the networks that process that information, and it inhibits other networks. Thus, the proofreader scans a page and spots spelling errors, and the cursory reader skims the same page and spots key content words and phrases.

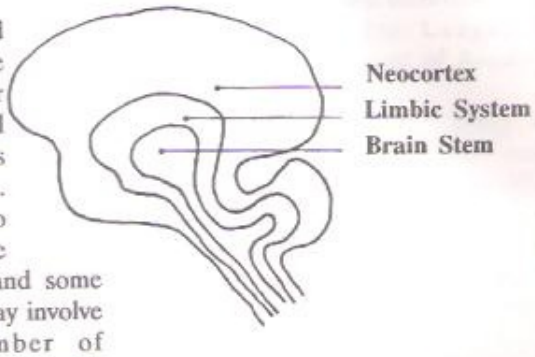
Finding a focus. Our principal attentional activity is the constant conscious selection of a current focus. We must extract what's most important from its context, and then focus on it while we merely monitor the context. The stupid attentional lapses and decisions we make, such as backing our car into a visible post, are a constant reminder that we have yet to achieve perfection in attending to the important and ignoring the unimportant. Emotion obviously dominates reason in many attentional decisions, and a stressful situation can chemically trigger an intense focus on something unimportant - such as when we work on an unimportant task to avoid facing a looming deadline on an important project.

Fortunately, our attentional system provides us with a short-term memory buffer that allows us to hold a few units of information for several minutes while we determine whether to go on to something else or store the data in our long-term memory. The advantage of this limited capacity is that it forces us to constantly select a relatively small focus of attention from a large (and often confusing)

Brain Systems That Help Determine and Maintain Attention

Neutrotransmitters

Norepinephrine and dopamine (two of the catecholamines) appear to be the principal neurotransmitter systems that process attention. Schizophrenia appears to involve excessive catecholamine activity, and some forms of hyperactivity may involve an insufficient number of catecholamines. Attention functions best with an optimum middle level of catecholamines.



A schematic model of the human brain by Paul MacLean[1]

Brainstem (or Reptilian Complex)

The brainstem passively receives incoming sensory information and starts the process of active attention. The reticular formation and locus coeruleus appear to control arousal and our abilty to ignore irrelevant stimuli.

Limbic System

The limbic system provides the emotional overtones and motivation for attention. The amygdala and hippocampus play librarian-like roles in the selection and classification of incoming information for long-term memory storage and retrieval.

Neocortex

The sensory lobes (the back half of the large sheet of neural tissue that makes up the neocortex) process the various forms of sensory information that our brain is attending to, and the frontal lobes control, fixate, and shift our attention - thus consciously determining what's foreground and background and how the current situation refers to our previous experience.

[1]P. MacLean. (1978). "A Mind of Three Minds: Educating the Triune Brain." In Education and the Brain, edited by J. Chall and A. Mirsky. (Chicago: The National Society for the Study of Education).

sensory field. The disadvantage is that it contributes to our human tendency to make inappropriate snap judgments.

Processing information. Our brain is designed to simultaneously process information from at least two non-competing stimuli or from different dimensions within the same modality. We can simultaneously observe a friend's face, listen to her talk, and reach for our car keys; but we can't read a novel and write a letter at the same time. We can also increase our ability to divide our attention in some areas. Young children can't carry on a conversation while putting on a coat but most older children can. An experienced teacher can monitor the specific behavior of more students than a beginning teacher.

Conceptual development increases our attentional span by combining related elements into a single unit. We automatically see a face as a single unit (rather than as individual eye/ear/nose/mouth elements), but readers, who generally focus on individual letters and words initially, have to learn to read entire phrases as single units. The intuition we ascribe to experts in a field may reside in their ability to size up a situation by identifying relationships among elements that novices don't recognise.

The chemistry of attention. Our ability to maintain attention is affected by normal cyclical fluctuations in the efficacy of the neurotransmitter molecules that chemically regulate attention. These fluctuations occur in 90-minute cycles across the 24 hours (Hobson 1989, p. 191). People differ in their rhythmic patterns, but at about 6 a.m. many people experience a sharp rise in the availability of these attentional molecules (which causes us to wake up), and the average level of the molecules remains relatively high during the morning. The average levels begin to decline during the afternoon and reach their lowest levels after midnight, when sleep becomes inevitable.

Unexplained curiosities abound - for example, our tendency to doze off around 3 p.m., when we should be awake, and to wake up around 3 a.m. when we should be asleep. Generally, however, we follow our body's predictable rhythms. We tend to do the things that we *have* to do during the morning, when it's easiest to maintain attention - and things that we *want* to do in the late afternoon and evening, when it's more difficult to maintain attention without the emotional support of personal interest.

We can simultaneously observe a friend's face, listen to her talk, and reach for our car keys; but we can't read a novel and write a letter at the same time.

Dysfunctions in attention. Dysfunctional brain mechanisms and/or chemical imbalances can lead to attention deficit disorder (ADD) and other attention-related problems such as retardation and schizophrenia. Although only a small percentage of students suffer from the form of ADD called hyperactivity (Attention Deficit Hyperactivity Disorder, or ADHD), their unfocused, restless, and impulsive school behavior is very disruptive.

It's probably that ADHD emerges at least partly from lower metabolic activity and specific neutrotransmitter deficiencies in brainstem and limbic system structures that (1) regulate motor inhibition and control, and (2) project into the areas of the frontal lobes that organize and regulate goal-directed attentive behavior.

Properly prescribed stimulant drugs (such as Ritalin™) that increase the availability and activity of our brain's neurotransmitters (catecholamine) seem to inhibit distracting stimuli and impulsive behavior and thus improve the child's ability to attend to appropriate stimuli - to separate foreground from background information and attend to the foreground. The diagnosis and treatment of ADD is still a controversial matter however, because of the drug's side-effects on some children.

Dyslexia is another serious attentional problem that we currently treat with limited success. Dyslexia researchers recently identified a coordination problem in the timing of the visual pathway systems (Livingstone et al. 1991). Our brain processes sensory information through two separate pathway systems: a fast system that processes the background (*where* objects are located), and a slower system that processes the foreground (*what* the objects are). The fast visual system of dyslexics appear to be sluggish. Thus, it doesn't erase the previous fixation quickly enough when the eyes move rapidly from word to word in reading, resulting in blurring and fusing words. Lenses that absorb certain light frequencies may be able to improve the coordination, but scientists currently don't know for sure (Livingstone et al. 1991). Similar patterns of sluggishness in the auditory system may cause some auditory attentional problems.

School Practices

Two general guiding principles for classroom management and instruction emerge out of our current knowledge about attention mechanisms and processes. First, teachers should adapt their instruction to the built-in biases and limitations of their students' stable attentional mechanisms. Second, they should use imaginative teaching and management strategies to enhance the development of their students'

adaptable attention processes.

The stable mechanisms. Even though the scientific understanding of our attentional system emerged only recently, successful teachers have long grasped the first principle at the practical level. For example, most learn early to do such things as flip the light switch off/on to get their students' attention (since a voice command carries little contrast in a noisy classroom), and to follow a repetitive sedentary activity with something enjoyably active (since interest and pleasure can reverse a currently depressed attentional system).

A more intriguing example of teachers' intuitive grasp of the first principle is the tendency of elementary teachers to schedule individualized skill subjects in the morning, and the less precise, more socially engaging subjects in the afternoon (PE, art, group subjects). It makes sense to schedule curricular priorities that require rapt attention and precise response during the morning, when it's easier to maintain attention. It is also logical to schedule interesting activities that demand less precision and sustained attention in the afternoon, when students' inherent interest in the activity will elevate their attentional level.

The principal problem teachers face with our attentional system's built-in bias for high contrast, novelty, and emotional overtones is that the curriculum presents a predictable universe: C-A-T always spells *cat*, and 6 times 5 always equals 30. We want students to solve such problems automatically and unemotionally, but mastery reduces their need to actively attend to the process. The result is that such routine, low-contrast curricular tasks tend to bore the same students who spend hours watching TV, with its emphasis on high-contrast, bizarre, and violent programming, which attracts active attention. It's a dilemma: the effective teaching of skills can reduce students' active attention to the process.

Again, teachers have creatively responded at the practical level through such - sometimes bizarre - behaviors as playing skill mastery games or threatening nonattentive students - in order to artificially increase their students' attention on otherwise unemotional, low-contrast learning tasks. For example, a math relay game is totally unrelated to mastering the multiplication tables. But since such games artificially engender attention-getting excitement through rapid action, teachers have intuitively used them to adapt their instruction to the processing realities of their students' stable attentional mechanisms.

The adaptable processes. Our profession's principal challenge is to help students learn how to consciously manage those adaptable aspects of their attentional system that aren't preprogrammed to enhance survival. In the modern era, human life is more than attending to immediate survival. It is now vital to attend to the quality of our lives and to the potential erosion of that quality.

Our attentional system constantly separates foreground from background and focuses on the foreground. If we don't consciously control the decision about what's important, the system will revert to survival needs - and we end up trampling the beautiful flowers at our feet in a mad dash toward survival. It's important that we teach students how to ignore an insensitive comment that wasn't meant to hurt, how to develop into adults who can appreciate a fine work or art without asking about its cost, how to simply observe a sunset.

We want students to solve such problems automatically and unemotionally, but mastery reduces their need to actively attend to the process.

The energy release by the plants that surround a rocket launch site is at least as socially meaningful as the energy used to launch the rocket. Although we automatically attend to the televised blast-off, we now have to learn how to attend to the equally important gentle growth of the plants in the background of the televised sequence: that's our curricular challenge.

A brain that can't control its own attentional system can be manipulated into thinking that background is foreground. Recent presidential campaigns have used shrill slogans to force limited but very emotional issues into the foreground, in order to meld more pressing and complicated national problems into the background. The electorate and the media, focused on their own survival, consistently fail to rise up in righteous anger to demand that the candidates reverse the attentional focus.

The Classroom as a Laboratory

Helping students attend to potentially important subtle differences and gradual changes is not in insurmountable challenge; educators have already developed many practical responses to an attentional system we didn't understand. We can expand effectively on what we already know and do. It's mostly a matter of emphasis.

Graphing can teach students how to identify gradual trends. Multicultural programs can celebrate both the unity of the human race and its subtle differences. History can explain how the past gradually became the present. Drama can demonstrate how a simple gesture can communicate what would otherwise take a page of script, and literature can allow us to look behind social facades.

Discussions, debates and story-telling activities force students to hold bits of information in their minds that they can use to respond to others when their turn comes up. Cooperative learning activities oblige students to attend to others' as well as their own contributions. Simulations, role-playing, and games require students to compare the real world with a created world. Metaphoric stories and dramas provide only the outlines of the story, forcing students to fill in the personal details. And metacognitive discussions about attention compel students to confront their own thought processes.

The bright, busy classroom environment we've developed with its 20-plus students and continuous flow of sensory information, forces students to constantly make foreground and background decisions, to attend and respond to events outside and inside their skull. We can use the classroom as a laboratory for student attention research. Good, simple ideas will easily emerge in an exploratory environment that, for example, attends to subtle differences in classification activities and gradual changes in prediction activities.

For example, a teacher may seek classroom analogies to larger population/pollution problems, and then have the class study and discuss them: the gradual build-up of classroom litter, the erosion of privacy in a group, the impact of hostile comments, the shifts in relationships. Before students can help solve such problems in the larger world, they must learn how to solve them in their limited world.

Simple activities such as these don't ensure a world solution to global warming and industrial pollution, but they do help students begin the process of attending to subtle differences and gradual changes. They help to reset our brain from its current built-in focus on the attentional problems of immediate survival to the subtler problems of the present and the foreseeable future.

It's a beginning, and attention is a process that celebrates beginnings.

Routine, low-contrast curricular tasks tend to bore students who spend hours watching TV, with its emphasis on high-contrast, bizarre, and violent programming.

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GLENN M KLEIMAN

Mathematics Across the Curriculum

In the Journeys in Mathematics project, teachers engage children in imaginative activities that inspire them to learn how to identify patterns and relationships, solve problems, and communicate accurately.

We often hear of writing across the curriculum and the writing process, reading in the content areas and whole language approaches to reading. But rarely, if ever, do we hear of mathematics across the curriculum, the math process, or whole math approaches. Except for its relationship to science, mathematics is the forgotten cousin in interdisciplinary teaching and learning.

Efforts to integrate mathematics with language arts, social studies, history, art or music are rare indeed. And as teaching in many subject areas moves toward more process-oriented, holistic, and collaborative approaches, mathematics is often left behind with its traditional workbooks, drills, and tests.

The neglect of mathematics in the movements toward interdisciplinary curriculum and new approaches to teaching stems in large part from misconceptions about mathematics that pervade our schools and our society. Many people see mathematics as isolated from other areas of study, irrelevant to everyday life, and devoid of creativity and aesthetics.

Learning mathematics is seen as memorizing facts, formulas, and procedures - as simply absorbing knowledge that has been handed down for generations. Many people believe that students must spend years learning formal mathematics before they can begin to think mathematically and use mathematics productively, and that only students with special talents can become mathematically proficient. Mathematics is thought to be its own world, accessible to only a select few, and, except for basic computation, of little relevance or use for most people.

The Humanistic View

This *dehumanized* view of mathematics is erroneous. Mathematics is, and always has been, essential to the human experience. Without mathematics, as without language, the nature of humanity and human society would have to be fundamentally different.

To be human is to seek to understand. Mathematics, along with science, has made possible dramatic advances in our understanding of the physical universe. To be human is to explore. Throughout history, mathematics has been essential for exploration, from navigating by the stars to travel into space. To be human is to participate in a society. Societies require mathematics to keep records, allocate resources, and make decisions. To be human is to build, and mathematics is essential for the design and construction of everything from tents to temples to skyscrapers. To be human is to look into the future. Mathematics enables us to analyze what has been, predict what might be, and evaluate our options. To be human is to play, and mathematics is part of our games and our sports. To be human is to think, to create, and to communicate. Mathematics provides a vehicle for thinking, a medium for creating, and a language for communicating. Indeed, to be human is to develop mathematics. Mathematics has developed in every culture for the purposes of counting, locating, measuring, designing, playing, and explaining (D'Ambrosio 1985, Bishop 1987, Gilmer 1990).

Viewed from this perspective, what we often teach students is an impoverished mathematics, one that focuses on detailed facts and procedures while neglecting the fundamental nature and value of the field. If we taught music as we teach mathematics, students would practice musical scales for years without ever getting to play a song. If we taught art as we teach mathematics, students would practice lines and shapes for years without ever getting to create a picture. And if we taught writing as we mathematics, students would practice spelling, punctuation, and penmanship without ever getting to use writing to express what they have to say.

Travels with Gulliver

In the Journeys in Mathematics project at the Education Development Center, we have developed a curriculum unit for grades 4-6, called

My Travels with Gulliver, which integrates mathematics with literature, writing, and drawing. In this unit, students read stories that incorporate mathematical concepts and they use mathematics to enhance their understanding of the stories and to create their own stories and drawings.

My Travels with Gulliver incorporate two stories. One, written specifically for the unit, begins with two students, Shaun and Tam, and their Aunt Linnea, who discover an old trunk that contains letters, maps, and mementos that belonged to the adventurer Lemuel Gulliver. These three characters learn about Gulliver's visit to Lilliput, the land of tiny people, from the letters and drawings in the trunk. They find a map and magic stone in the trunk, and they travel to Titania (a land created for this unit) where everything is four times the size of comparable things in Ourland (the name used in the story for the land in which we live).

The second story is "Gulliver's Voyage to Brobdingnag," from Jonathan Swift's classic book, *Gulliver's Travels.* Students listen to a recording of Gulliver's adventures in this land of giants. Swift's story provides information about the sizes of many things in Brobdingnag, where people and objects are 10-12 times as large as similar things in Ourland.

"Gulliver" Activities

These two stories motivate mathematical explorations, creative writing, drawing and discussions. Here are some sample activities:

- Student measure actual-size tracings of people, animals, and things from Lilliput. They use their measurements, and measurements of things in Ourland, to estimate the sizes of other things in Lilliput. For example, they measure a tracing of a typical 12-year-old Lilliputian child and find it to be 4.5 inches tall. How large, then, would a child's desk be in Lilliput? How large would a Lilliputian classroom be? The child's mother and father?

- When listening to Gulliver's adventure in Brobdingnag, students collect information about the sizes of things in this land of giants. They find, for example, that a Brob farmer holds Gulliver 60 feet from the ground, a hedge is 20 feet high, a stairstep 6 feet high, and a serving dish 24 feet across. They use this information to determine the *scale factor* that relates the sizes of things in Brobdingnag to the sizes of things in Ourland and to discuss which things are in standard sizes and which come in a range of sizes.

- When students meet Glumdalclitch, a 9-year-old Brob girl who takes care of Gulliver, she is described as "small for her age, not over 40 feet tall." This leads to the question of what around us is about as tall as Glumdalclitch. Students seek ways to estimate the heights of such things as buildings, trees, and flag poles to get a concrete sense of the sizes of people in Brobdingnag.

- Students make actual-size drawings of objects from Titania and Brobdingnag. For example, they might make giant pencils, calculators, or books. After students meet Weldren, a Titanian girl, each student draws one part of her face - her eyes, nose, mouth, ears, and hair. Students then combine the parts and draw her head. Making these drawings involves careful measurement of each part of the object and the use of strategies for rescaling shapes. Combining the parts of Weldren's face provides a ready check of whether each student did his or her work accurately.

- The drawing activities lead to considering perimeter and area. How much material would it take to frame each drawing? How does this relate to the amount of material needed to frame an actual-size drawing of the Ourland object? How many of the Ourland objects are required to completely cover the Titanian-size drawing? Is it the same number no matter what object was drawn?

- There are many opportunities for creative writing within the unit. Students create their own adventures in Lilliput, Brobdingnag, and Titania. They write about visits to Ourland from Glumdalclitch and Weldren. They use information about measurements and size relationships to make their stories realistic and accurate.

Creating New Lands

At the end of the unit, students create their own lands. They describe the sizes of things in their land, write stories about the land, draw pictures, and create travel brochures to encourage people to visit their land. One student wrote about visiting a Brob classroom:

I was walking toward the front of the Brob classroom, hoping that the teacher would notice me. A giant log was in my way. I suddenly realized that the log was really a pencil that one of the young "Brobs" had dropped, for in a matter of seconds, a five-foot-long hand reached down to the floor. It began scrambling around, trying to find the pencil. Suddenly, the hand seized me by my knees! "I'll use this stubby pencil," the Brob murmured, as it brought me up to the desk. I wanted to scream, but I couldn't get hold of my voice. Without even looking at me, he (now I knew it was a he) absentmindedly started to doodle on a piece of paper, using my feet as a tip. As the teacher walked by, he rapidly turned me around, and used my head as the eraser. "Ouch!" I yelled. Shocked, he dropped me. I can't believe I actually survived the 28 foot drop from the desk to the floor!

Another described a walk along a Brob street:

I was walking along one of Brob's huge sidewalks which was like walking in a gigantic Logan airport. Suddenly I bumped into something. It was a Pepsi can four feet, two inches - up to my chest. I figured out a way to get by it, somehow, and I found myself stuck on a piece of bubble gum bigger than my foot! I was about to step and I saw a two foot six inch, five inches high log. What was it? A cigarette! My does this place have litter!

Other students created life-size pictures of objects from the lands of giants.

These activities and student work illustrate how mathematics can be

well integrated with literature, writing, and drawing - areas that are often thought to be nonmathematical.

Units for Middle Schools

In a new project, Seeing and Thinking Mathematically, also funded by the National Science Foundation, we are developing a middle school mathematics curriculum that will include a variety of interdisciplinary activities.

For example, the unit *Yesterday and Tomorrow* will involve students in researching data about changes in years past, identifying trends or patterns in the data, and making predictions about the future. Students might analyze the changes of their town's population and the relationship to the number of cars, businesses, schools, and so on. This unit will involve students in mathematics concepts such as linear, cyclical, and exponential change.

The unit *Designing Spaces for People* will involve students in measurement and design. Students might take part in such projects as planning ramps that would provide access to people in wheelchairs. Considering how long a ramp should be will lead into mathematical explorations of angle, slope, ratio, and similar triangles.

Other units will focus on the mathematics of such areas as maps and map-making (measurement of distances and scale), art (perspective drawing, concepts of symmetry and balance), sports statistics (averages, percentages), and decision making (probability of outcomes).

Connecting Mathematics to Experience

Viewing mathematics within the human experience leads to mathematics teaching that shares many basic principles with the writing process approach.

Both are based on "holistic" views of learning - that children should start with real goals and accomplish real tasks from the beginning, and that the learning of specific skills and facts should take place within the context of these tasks. The writing process begins with the central function of writing - for the individual to express and communicate his or her own experience, thoughts, and feelings. The mechanics of penmanship and the details of punctuation, spelling, and grammar serve this larger, holistic function, rather than being ends in themselves. Likewise, mathematics instruction can begin with the central functions of mathematics - to identify and represent patterns and relationships, to solve problems, and to communicate precisely. The mechanics of algorithms and the details of facts and formulas *serve* these functions.

Mathematics, like writing, can build upon what young children already know and do. In writing, the basis is the child's general experience and ability to communicate in speech or sign language. In mathematics, the basis is the child's experience with actions such as combining, sharing, and comparing, the child's developing concepts of time and space such as *before* and *after* and *near* and *far*, and the child's natural recognition of visual, musical, and movement patterns.

When mathematics is connected to the human experience, the same type of classroom culture advocated in the writing process - one that supports collaborative work, discussion, and sharing of ideas, mutual respect for each learner's approach, and students' sense of ownership of their work - becomes essential for mathematics learning. The teacher's role within this culture is not the knowledge-giver of the traditional mathematics classroom, but rather a facilitator of students' learning and a participant in using and discussing mathematics.

Mathematics provides a language for quantifying, measuring, comparing, identifying patterns, reasoning, and communicating precisely. This language, like English or any other natural language, can provide a means for understanding, analyzing, and communicating across the curriculum and throughout students' lives. It's a language children can bring into the worlds they create.

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MARCIA HEIMAN

Learning to Learn

Applying techniques used by successful learners, previously unsuccessful high school and college students are staying in school and earning higher grades.

When I was in high school, I hated school. I never read nothing, never did no school work. I dropped out of school as soon as they let me.

I couldn't get no job, so I decided to see if college was better. I went for my GED, and came to Roxbury Community College. I didn't do good for my first semester here - I failed two courses. Then I took Learning to Learn, and things really changed. I had to think about my schoolwork. Reading was like playing some game - looking for the answers to my questions. I'm a business major, and now I can even do hard subjects like economics and accounting. It's like I think better. Math was a jumble for me. Now I see how to do the parts and how they fit together.

Used to be I couldn't see no future for me. Now I can see my way to a four-year college education. I just wished I took Learning to Learn in high school, so I didn't need to waste no time like that.

- student at Roxbury Community College.

During the 1960s, a group of researcher-clinicians at the University of Michigan took a non-traditional approach to improving students' learning strategies. Rather than using a diagnosis-and-remediation model, which at best results in only a year's gain in a year's time, the Michigan group sought to discover skills that are critical to successful learning. If skills of successful learners could be identified and translated for use with less successful students, the group felt that learning gains might be more rapid.

Over a period of several years, these researchers observed the learning behaviors of successful students as they verbalized their thinking while solving a variety of complex academic tasks. They found that good learners:

1. "Program" their learning for content courses - identifying the component parts of complex principles/ideas and breaking down major tasks into smaller units.
2. Ask questions about new materials, engaging in a covert dialogue with author or lecturer,

Figure 1. Overview of Learning to Learn

	General Skills	Subject-Specific Skills
Input Stage	Generating questions from books, lectures, notes and handouts	Reading to solve problems in chemistry
	Reading for examples	Reading diagrams in biology
	Reading graphs, tables, and diagrams	
	Developing editing checklists for math and grammatical composition	
Orientation Stage	Constructing information maps and flowcharts	Constructing an information map comparing the cultures of two countries, using student-generated questions derived from class discussion
	Using a tasks/skills checklist	Constructing flowcharts to improve the structure of written assignments
Output Stage	Writing to answer questions	Using a student-constructed information map to study for an objective exam in geography
	Systematic problem solving	Using a five-step approach to solving word problems in geometry
	Constructing mock exams	
	Writing key-word diagrams	

forming hypotheses, and reading or listening for confirmation.

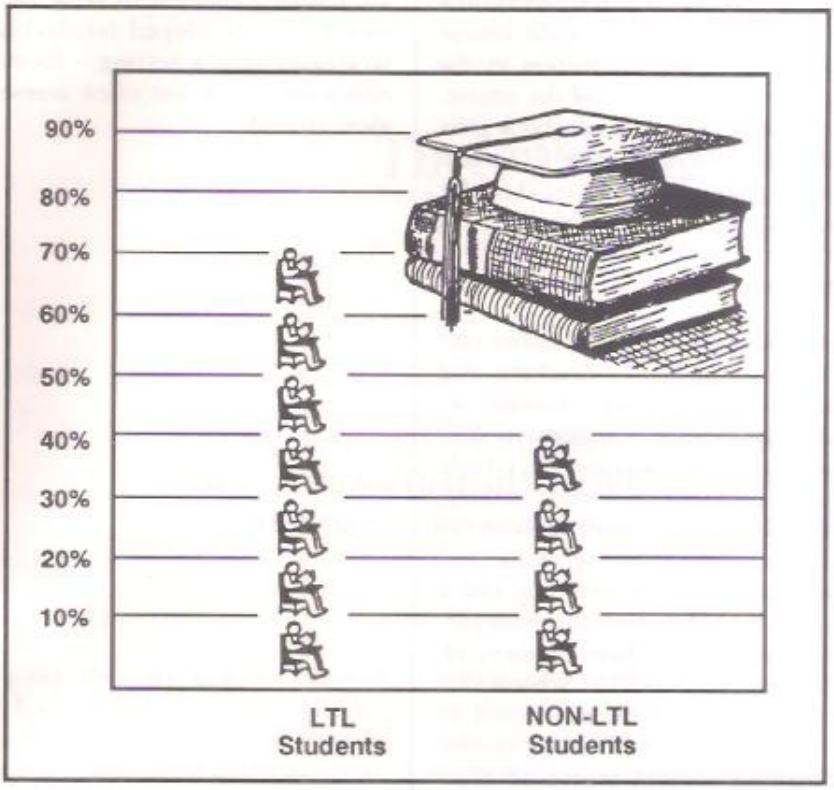
3. Devise informal feedback mechanisms to assess their own progress.

4. Focus on instructional objectives, identifying and directing their study behaviors to meet course objectives.

The Michigan group translated these skills into a series of exercises that students could apply directly to their academic work. I joined the group in 1967. Since then, as director of a number of college learning centers, I have sought ways to apply the four general skills to a wide range of academic areas and to adapt the techniques to students of varying entry skill levels. In 1979, I was joined in this work by Joshua Slomianko, who has helped put the skills into the framework of a cohesive system and found applications to new contexts. The resulting combination of skills and instructional materials constitute Learning to Learn (LTL).

Learning to Learn has three stages: *input* (gathering information), *organization* (arranging information for further analysis), and *output* (student demonstration of mastery of the material). Students learn to build general learning skills and subject-specific skills into their daily school work (see Figure 1). After a few months of adapting these skills to their coursework, most students report that they become involved with school work and that they begin using the skills automatically. For example, one student said, "I used to fall asleep in class and over my books. Now I want to know what's going on. I ask myself, "What's the teacher after now? Is he answering my questions, or is this something new?" As students begin to "play" with the material in their courses and discover their own variations of the skills, they increasingly view the skills as aspects of two central learning tools: generating questions and breaking down complex ideas and tasks into simpler, more comprehensible parts.

As a result of work done with educationally disadvantaged college students reading as low as the 5th grade level, the U.S. Department of Education's Joint Dissemination Review Board approved Learning to Learn for national dissemination. Data from controlled studies show that the program has significant, long-term effects on students' grade point averages, the number of academic credits they complete per semester, and their retention in school. For example, a study conducted with students reading at the 6th grade level at Roxbury Community College showed that LTL students earned a 2.9 grade point average; comparable students who received traditional remediation (for



Three semesters after treatment was completed, 70 percent of the LTL students were still in college or had graduated, as compared with 40 percent of the non-LTL students.

example, content-course tutoring or basic skills support) earned a 2.2 grade point average (Heiman, 1983). LTL students also completed significantly more academic credits per semester. Three semesters after treatment was completed, 70 percent of the LTL students were still in college or had graduated, as compared with 40 percent of non-LTL students.

Learning to Learn in Secondary Schools

Learning to Learn has now been piloted by teachers in several Boston-area high schools. In 1985-86, the program is being fully implemented in a number of schools, including Winchester High School, West Roxbury High School, and the Massachusetts Pre-Engineering Program at Boston Latin High School in Massachusetts; Kings Park Junior and Senior High Schools in Long Island; and Taft High School in Cincinnati.

Learning to Learn is most effectively built into students' academic work in two ways:

1. *In the content classroom*. In both junior and senior high schools, teachers incorporate LTL skills directly into their classroom teaching. The following vignettes illustrate this process:

- Robert Stone's 10th grade chemistry class has been assigned Chapter 7, which discusses the relationship among temperature, pressure, and volume of gases. Students work in pairs, generating questions from the text and using an active method of reading to solve problems. In this regard, their chemistry texts become "dictionaries" that help them solve the sample problems presented in the text.

- Amy Anderson's 6th graders will be studying a unit on Africa. Working in small groups, they have identified questions to which they would like to find answers. Their questions will be the basis of small-group "research" projects, in which they will find answers to their questions in an encyclopedia. Each group has at least two "resource" persons who read at the 4th grade of higher.

- Albert Hart has just given a brief lecture on Greek city-states to his 9th grade social studies class. Students took notes on his lecture. Later, working in pairs, students will help each other fill in missing notes and generate questions from those notes. They will then use their questions to read-to-find-answers in the textbook chapters on Greek city-states.

As these illustrations suggest, Learning to Learn has a wide range of applications for content classrooms. Classroom management problems are minimal because student motivation is high. By looking for answers to their own questions and breaking down complex ideas into manageable units, students gain a sense of mastery over their academic work. Their information search becomes personal, as they are working to achieve goals they have set for themselves.

2. *As a credit course.* In the senior high school, Learning to Learn is also offered as a year-long credit course. Students are required to adapt the appropriate LTL skills to content-area courses taken concurrently with LTL. Students learn how the skills relate to each other by learning principles on which they are based and how to vary the skills for a wide range of academic tasks. The course is designed to make students independent learners in any academic course, whatever its structure.

Learning to Learn is available to schools through a combination of training workshops and instructional materials. Content-area teachers receive field-relevant instructor manuals, which review those skills most suited to a particular discipline, suggest ways of using the skills as classroom activities or homework assignments, and provide sample lesson plans. Manuals are available for teachers of social studies, English, mathematics, physical science, and biology/earth science. In addition, student workbooks are available in these areas (such as *Learning to Learn Social Studies*).

A detailed manual provides teachers of the LTL credit course with step-by-step instruction in the content and structure of the course. In addition, a student workbook gives students practice in using LTL skills and suggests ways to adapt them for use with content classwork.

Positive Outcomes

Learning to Learn has positive outcomes for students, teachers, and school administrators. Students become more actively engaged in their work and can improve their basic skills (primarily in reading, writing, and listening), content-course grades, and reasoning skills. Improved student motivation and a higher level of student classroom participation, in turn, have a positive effect on teacher morale. Schools that fully use the system can expect to realize some of the following results: improved student scores on competency exams, improved student retention through graduation, and more students going on to post-secondary schools.

One reason for the system's effectiveness is that it provides students with an environment conducive to active learning. Students are not simply advised to improve their organization, motivation, and interest in school. Rather, as the student quoted in the beginning of this article suggested, students develop tools for turning academic work into a kind of "game" in which they predict questions and answers. The dichotomy between "real world learning" and "book learning" begins to diminish for many students as they see the relationships between the kinds of learning they do in daily life and in academic settings.

The useful effects of Learning to Learn appear to be a product of its basic approach to higher-level learning: the skills that are central to the system (generating questions, identifying essential parts of complex situations, looking for feedback on progress, directing behavior toward clear goals) are part of *all* learning. Learning to Learn works because we are teaching children to bring their own highly developed intellectual strategies into a setting - formal education - that has often seemed alien ground.

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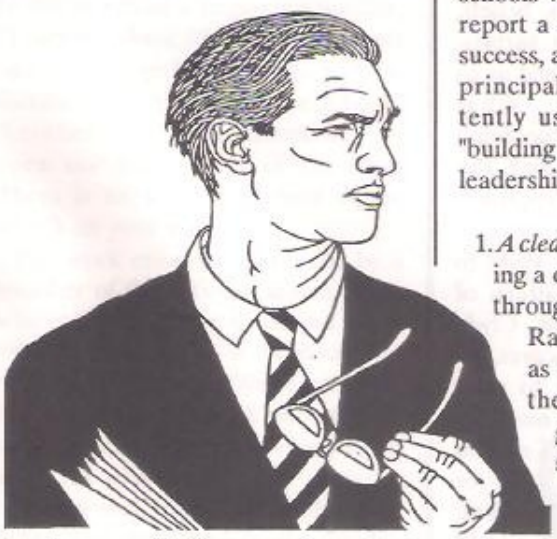
RICHARD D SAGOR

Three Principals Who Make a Difference

A close-up look at three transformative leaders in action shows that although they come in different shapes and sizes, they share one thing: exemplary schools

Why do some schools succeed when others fail? This question has driven reform for generations. In recent years, organizational structure and culture - in particular, shared decision making and teacher empowerment - have been touted as major determinants of effectiveness. But is decentralization alone the magic elixir?

Our research suggests *no* - at least, not without transformational leadership. The issue is more than simply who makes which decisions. Rather, it is finding a way to be successful in collaboratively defining the essential purpose of teaching and learning and then empowering the entire school community to become energized and focused. In schools where such a focus had been achieved, we found that teaching and learning became transformative for everyone involved.



Opinionated assertive "Clyde"

Three Key Features

In helping the faculties at more than 50 schools with Collaborative Action Research (Sagor 1991), we've noticed an interesting trend. In schools where teachers and students report a culture conducive to school success, a transformative leader is the principal. These principals consistently use what we call the three "building blocks of transformational leadership":

1. *A clear and unified focus.* Developing a common focus doesn't occur through spontaneous generation. Rather, a leader usually serves as the medium through which the collective yearnings of a group of empowered professionals can take form and give direction for both group and individual work (Peters and Waterman 1982).

W2. *A common cultural perspective.* It's important for teachers to view their organization through a similar lens. In our work, we ask teachers to rate 14 elements of their school culture that are known to influence performance (Saphier and King 1985). In schools where teachers share a common view of their school's culture, improvement seems to occur more easily than in those where teachers disagree on issues such as the degree of collegiality among the staff or the importance of risk-taking and experimentation.

3. *A constant push for improvement.* Our research supports Fullan's (1986) belief in the importance of the simultaneous application of pressure and support during educational change. We studied schools where despite significant financial and emotional support from district and building administration, the direction of improvement was disappointing. Meanwhile, other schools that received less support were making impressive gains. Likewise, we encountered settings where expectations were high, yet performance was low. The secret seemed to be in providing the right combination of pressure to improve, along with meaningful support for the improve-

ment initiatives themselves.

To understand the role leaders play in developing and sustaining these important features, let's look at three very different principals who have one thing in common: they oversee exemplary schools marked by heightened student and faculty morale, as well as high and improving student performance.[1]

An Opinionated, Assertive Principal

Clyde Adams had successfully led two large high schools and two middle schools in other districts when he came to Wilton Middle School, a tradition-bound, highly regarded, yet physically dilapidated school. At Wilton, students' scores had historically been high, faculty turnover low, and a culture of self-confidence and professional esteem ran as deep as the layers of paint that covered the old wooden building. The teachers were so sure of themselves that many nodded agreement with the comment, "This school runs itself; we don't even need a principal."

Clyde, a large, athletically built, middle-aged man, didn't subscribe to their view. While he held the staff's accomplishments in esteem, his review of the data showed that not all Wilton students were achieving academic success, that there was still much work to be done.

On the surface, Clyde personified the classical masculine leadership model: self-assured, direct, and personally formidable. When we started studying Wilton, I'd have bet that a self-confident, self-actualized professional teaching staff like Wilton's, with a long history of success, would have put such a leader in his place - and quickly!

If that prediction seems harsh, consider this: Clyde came to the school deeply opposed to tracking. Yet the senior faculty members were equally committed to maintaining ability grouping and, further, considered it a chief reason for the school's success.

Clyde began work in July. By August, it became apparent that the maintenance department would not get to his building before school started. That didn't faze Clyde. He promptly donned overalls and, with the building custodian, painted the staff room, the cafetarium, and other areas in the school. He scrounged carpet and draperies. On the day after Labor Day, the staff found a warm and hospitable lounge to work in.

During the summer, Clyde hired six new faculty members, a number equaling 20 percent of the faculty. They were young, enthusiastic, and hardworking. During the hiring and induction process, Clyde informed the new staff that from day one he wanted them actively involved in school decisions. However, the veterans were not to be left out. They were already accustomed to full involvement in governance. Clyde's agenda was to expand and systematize the faculty's role in decision making. He explained his approach this way:

> Every staff member is involved in a group or committee while we are working toward consensus. Once groups are established, we can make changes and decide on beliefs. Faculty meetings provide an opportunity to bring together all the small committees. I like to let people try out ideas and am willing to allow for failure.

Thus, the year began with Clyde, the new faculty, and the veterans deliberating on school goals, beliefs, strategies, and visions. Not surprisingly, tracking quickly emerged as an area of disagreement. What surprised us was that the issue didn't generate the rancor we expected. The key appeared to be Clyde's approach to leadership.

Several times during our visits to Wilton, we witnessed a pattern of principal-teacher interaction. Clyde would use some data (test scores, attendance reports, surveys) to raise perplexing questions. The meetings would then take on a tone of excited inquiry. "What if we tried ...?" or "Could we find out if ...?" Then, without hesitation, Clyde would grant whatever support was re-

If Clyde cuts the image of the classical masculine leader, Nora presents a sharp contrast: she is a nurturer, a listener, and a supporter of faculty, students, and parents.

quested. And he never let the faculty deal itself any grunt work. If data had to be obtained, graphed, or sorted, he'd say, "That's our job in the office. You don't need to waste your time on it!"

The Wilton faculty held their homeroom program in high regard. Upon arrival, Clyde formed his own homeroom group of the most at-risk marginal kids in the school. His goal was to make them successful students. He also created his own basketball team comprising the kids least likely to ever try out for or make an inter-scholastic athletic team. His team was soon challenging the faculty, the varsity, and all comers to good-natured competitive games.

"Action research," Clyde told us, "is a way of sharing power." Not surprisingly, when the time came to find a focus for inquiry, Wilton's action research team chose tracking and its impact on attitude and achievement. Every participant came to the research project with deep biases. Half of the team was certain tracking was the source of the school's success; the other half thought it was holding them back. Did this produce hostility and divisiveness? Not at Wilton. At this school, it became a justification for inquiry, professional debate, and data-based decision making.

At Wilton the teachers work hard, work together, and work for the kids. In the words of a beginning teacher, "Teachers share ideas and concepts and work together formally and informally for the good of the school." Another teacher commented, "We open our big mouths all the time. There is no fear here about saying what's on your mind."

The work ethic was captured by a member of the action research team, who confided, "We're buried right now. On the edge of burnout, but there is celebration. We're stressed, but I guess if we laugh enough, our sense of humor keeps us ready to go again the next year."

At year-end, Clyde was firmly established and well liked by the faculty, although self-confidence would still cause many teachers to agree that

A teacher on the action research team observed that she motivates "through her actions. If we are going to have a long day, we are sure she is going to have a long day."

"this school could run without a principal." Recently the faculty amicably agreed to replace tracking with heterogeneous grouping. School goals, recently revised, now have a focus on the disadvantaged learner. In addition, the faculty created a paid academic coaching position to work with failing students after school in the same manner as the athletic coaches.

Did opinionated, assertive Clyde direct that these changes be made? No. Would they have occurred without him? We suspect not.

A Nurturing, Supportive Principal

Like Clyde, Nora Burns is a veteran principal. Two years ago she had been given the opportunity to realize a dream: open a new elementary school. For a year, Nora served as planning principal and as the district personnel director. To argue that Nora avoided using her position to construct an incredible faculty for Bedrock would be to tell this warm, soft-spoken grandmother short. Nora has a reputation for being able to get what she needs and wants. But the secret of Nora's success doesn't appear to be traditional power politics!

If Clyde cuts the image of the classical masculine leader, Nora presents a sharp contrast: she is a nurturer, a listener, and a supporter of faculty, students, and parents. Over the years,

Nurturing, supportive "Nora"

top teachers in her district repeatedly requested and received transfers to the buildings where Nora was principal and weaker ones sought transfers out. When asked about this trend, Nora seems unwilling to acknowledge that she has anything to do with it. But when we observed her and talked to the teachers, her leadership became apparent.

Nora doesn't lecture, nor does she challenge. Rather, she is all over the building, finding the good things that are happening for kids and openly delighting in them. The responsible teacher's excitement is then visibly amplified by her enthusiasm, encouragement, and offers of assistance. When Nora later suggests an idea for consideration, it is taken as advice from a sage friend. Something in her demeanor tells you that while Bo may know sports, Nora knows instruction! Even so, she readily admits to being a learner. One of the things she enjoys most about her job is that "I'll never know it all, so I'm always looking for better things to do." Consequently, she affords others the opportunity to lead. In fact, many faculty members acknowledge her instructional coordinator (the district's equivalent of an intern) as the school's instructional leader. Her success in cultivating and developing leadership is evident in the fact that three of the other five elementary principals in her district once worked for Nora as either instructional coordinators or teachers.

Nora insisted, and faculty interviews corroborated, that hiring decisions were not based upon a commitment to certain educational policies. However, everyone agreed that they were conditioned on adherence to certain core values. Specifically, Nora sought teachers who had inquiring minds, a commitment to collaboration, and a belief in child-centered education. When this new group convened at a summer retreat to plan the program and chose multi-aged grouping as their organizational structure (something unprecedented in the district), observers might have suspected a setup: Nora's support for that innovative practice was already well known. Were these people hired because of a predisposition toward multi-aged grouping? Not so, argued the faculty. Nora offered them data and provided reading material for consideration, but the decision to implement was theirs alone.

In September 1990, 8 of the 12 Bedrock teachers signed on as an "action research" team charged by their colleagues with documenting the impact of multi-aged grouping on all aspects of the program. A large staff-parent advisory committee was also formed to help guide the school. At first, the parents (many upper-middle class professionals who selected the community because of its academic reputation) were suspicious of this new organizational structure, and the teachers were understandably defensive about the parents' critical attitude. Not Nora. She simply saw this as an opportunity to educate.

Bedrock is a school, albeit new, that swims in data. Every question posed by a parent or a teacher is affirmed as appropriate. When challenged, Nora never shows the least defensiveness; instead, she clarifies the concern, asks what data would help allay or confirm the concern, and then sets out to acquire the necessary facts. Consequently, in response to their requests, Bedrock parents have seen everything from scattergrams of student achievement levels in the mixed-aged classes contrasted to conventional grouping (the ranges were almost identical) to student and parent surveys on every conceivable affective and academic concern. By all appearances, the parents now support the multi-aged approach. Nevertheless, each year its continuance is up to the faculty.

High-energy charismatic "Laura"

At year-end, all available measures of student achievement were high, faculty morale was soaring, parental support was strong, and the faculty had decided to go another year with their experiment in multi-age grouping.

Could a district or principal direct a staff to successfully implement such a radically different organizational structure? Maybe. But, not with this group of teachers. These teachers assert that they have been successful because *they* are the decision makers.

Does the faculty feel Nora is essential to the process? Absolutely. In the words of one teacher, she "is receptive to teachers' attitudes and philosophies, so teachers are empowered. She communicates confidence in me. She repeatedly tells me "I want you to be the best teacher in the school district."

A High-Energy Charismatic Principal

Laura Carson - vivacious, energetic 40-ish - appears most comfortable with her arm around a child. She serves as an elementary principal in a district of 29 schools that has generally hired from within. She was the exception. Laura joined the district with a well-earned reputation as a maverick from a small neighboring community.

A district administrator calls Laura a mixture of "charisma and chutzpah." Although she describes herself differently, Laura clearly un-

derstands her leadership style:

I'm high energy. I took over a leadership role where teachers were isolated. I asked them to leave their doors open. I spent a lot of time assisting in the classroom. It was tough the first couple of weeks. Teachers wouldn't take responsibility. They hadn't ever worked together.

I started real slow and asked, "What do you want to work on?" They brought up writing. Two teachers put together the plan. It came together easily. Writing was a building need - the test scores showed that. I was having a real tough time getting this group going; then I saw information on Project LEARN and thought it was a great way for administration to get people talking in the building. So I talked to two teachers who volunteered to be involved. That was the area they selected. Everything fell together easily. It was luck.

The teachers view the change in leadership similarly, yet they don't ascribe it to luck. For example, one teacher recounted that the new principal "was immediately accepted by the old staff. She is an action person. If you have an idea, she picks up the phone, and it's done. She takes care of things; she sees projects through". Another teacher talked about how the principal had completely changed the school by having high expectations for teachers and students: "People are working harder, putting in more hours in the classroom."

This path for improvement is quite public. One of the classified staff commented that the principal had had a big effect on student achievement and the atmosphere in the building: "We are busy with new projects and new ideas. The principal backs people, plus she gives follow through and support. She gives all of us responsibilities."

One thing that repeatedly came up in conversations was the way Laura involves staff in critical governance functions. She pointed out:

I try to get them to pick a focal point. At the first of the year, we establish goals and how we will reach them. We form communities, share and discuss research. I let teachers experiment with their ideas and research. They need to realize that this is a joint effort, a total school. Teachers here are responsible for all students, not just their own classes. I expect teachers to give 100 percent.

One teacher added:

Committees have a floating chairmanship. The principal asks people to work on something and get back to her. She doesn't hold it over you, saying "I'm the boss." I think she just enjoys her job. She wants the school to be good and the teachers to do a good job.

A long-term member of the staff described Laura as a principal with "strong values and beliefs. She evaluates what is happening and makes suggestions, and so far she has been right!" One of the teachers noticed that she "is in the faculty room all the time. The principal proposes new ideas. Then people kick them around." Another put it this way:

She puts things in the bulletins like, "So and so has a great idea. Go and see it." She praises teachers just like teachers praise students. She'll notice that you've spent a lot of time on something and will tell you that you've done a good job. And when I'm praised, just like a child, I want to do an even better job.

Laura says that she surveys the staff often about their needs and wants. She adds that her staff continually exceeds the district's yearly staff development budget of $500 per teacher. In her words:

I bypass the district restrictions on out-of-district inservice programs. I'm not afraid to disregard district policy. I bring workshops here to the school, where it is comfortable and teachers can participate. I get teachers here to share their talents with one another. That is a pat on the back for those teachers. And I delegate to those teachers who are not participating. I ask them to be in charge, to chair a committee. It gets people involved, and all departments are represented.

Laura's commitment inspires extra effort from the staff. A teacher on the action research team observed that she motivates "through her actions. If we are going to have a long day, we are sure *she* is going to have a long day."

The teachers at Riverview regularly work well beyond their contract time

Clyde, Nora, and Laura help us see how leadership can influence school culture so that it has a transformative impact on the professionals who work in the schools.

on collaborative projects. This commitment was apparently the result of participation on committee work and delegation of responsibility. It may also have to do with expressions of appreciation. As one teacher put it, "It comes from inside, from being told that you are doing a good job."

Another staff member summarized Laura's impact this way:

> The principal is moving the lazy old staff out - bringing in new staff, high-energy people who are willing to spend time, even their own money, on the school. People want to do a good job for her. She is always in the classroom. She is positive about teachers and the work they put in.

Collaboration is the key at Riverview. Although only two teachers took the action research training, the entire staff participated in their writing project, and after one year writing performance was way up. The next year, two other teachers took the lead. This time the focus was using computers for word processing. Again everyone joined, and again student scores improved.

Did the talent and drive to make these accomplishments come from Laura? No, they came from the staff. Would the staff have demonstrated those talents without her? We don't think so.

A Common Thread

Laura Carson, Nora Burns, and Clyde Adams embody disparate leadership styles, yet all three have one thing in common: a transformational effect on the professionals who work within the shadow of their leadership. They also share certain behaviors. Each principal endeavors to visit each classroom every day, practices active listening, and views teaching as an experimental science.

In all three schools, the faculty feel empowered. They take credit for the school's focus, even though they acknowledge the principal's role in giving it voice, support, and strength. Although Laura is a writing process devotee, Clyde a fan of heterogeneous grouping, and Nora a believer in multi-aged grouping, the faculties at their schools didn't feel manipulated into adopting those perspectives.

The role leadership plays in creating common understandings of the culture is similar in all three schools. While large meetings and grand symbolic actions play a part, the most significant change in work culture is accomplished in one-to-one personal interactions. The combination of focused effort and collection of data gives teachers a feeling of efficacy, motivating them to voluntarily work countless hours for the intrinsic rewards of teaching.

Finally, the continuous asking of probing questions that go to the heart of the teaching/learning process enables all three principals to maintain the pressure necessary to foster school improvement. Yet, in each case these principals provide teachers with the meaningful personal support that creates a willingness to go above and beyond the call of duty.

Clyde, Nora, and Laura help us see how leadership can influence school culture so that it has a transformative impact on the professionals who work in the schools. In these three schools, that type of leadership has been shown to make schooling more effective for students and more professionally rewarding for the teachers.

[1]The principals and the schools described here are real. The names used are pseudonyms.

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LEONG WING FATT

The Colleague Supervision Conference: A Transformational Approach To Help Achieve Quality Lessons

A head of department in a primary or a secondary school is expected to supervise the work of teachers in his department. The work to be supervised includes the way the teachers conduct their lessons. Supervision refers to what a supervisor does to ensure that workers under him are performing their assigned duties as expected. Supervision also refers to when a "...supervisor formally evaluates an employee's performance and shares this assessment with the worker." (Siegel et al. 1985).

In the context of training for school leadership, heads of department must learn how to carry out this function because it is really not easy to do and, as Douglas McGregor (1960) once said, "It is an open question whether subordinates in general really want to know where they stand."

There are more ways than one for a head of department to carry out his supervision duty. The usual way is to follow an approach based quite naturally on the superior-subordinate relationship. Such an approach is 'hierarchical' and **authority-based** , and has its origin in the inspection line in a military camp or the check-list control procedures of the factory floor. An additional way partially outlined in this paper is to follow a colleague-based approach that depends much more on mutual respect and professional consultation between fellow team-work members as in a typical task group. This colleague approach is characterized by joint problem-solving between two (or more) **equally competent practitioners** who are desirous of searching for ideas to help raise the quality of their professional practice. While the usual approach depends mainly on detecting strengths and weaknesses of the teacher for its implementation, the colleague approach is principally driven by a mutual vision of what a great performance looks like, and so it is capable of transforming our performance.

Supervision ... ensuring that workers are performing their assigned duties

In our schools, we strive to foster a colleague-centred working environment and a spirit of team-work in the various departments. We readily acknowledge our fellow colleagues-in-teaching as professionals who are capable of exercising expert judgement in the performance of their duties. We have great faith in each others' ability to fulfill the schools' mission. A mutual trust exists to bind

Joint problem-solving by two equally competent practitioners

us together and guarantee that our collective service is the best that we can provide our students. Where true team-work exists, and especially, as Peter Senge (1990a) had said, when teams are truly learning as well, extraordinary results are produced and individuals grow more rapidly than they could otherwise.

In a colleague-centred working environment, the hierarchical, authority-based approach to supervision may not be sufficiently suitable, especially when used in pre- and post-lesson observation conferences. This is the case even when the conferences are conducted as pleasantly and with as little threat as possible. The main reason for the inadequacy in this authority-based approach lies in the recognition that people have a need to 'put their best foot forward'. A normal person needs to believe that others do think well of him. The most important person with whom an individual wants to present a good impression is usually his immediate superior at work. If, for example, a worker receives a criticism about his work directly from his superior officer when he is anxious and trying hard to please, he could experience a lot of stress. Seigel et al (1985), writing for the US manager, even warned that, "...for many employees this criticism does not lead to improved performance, but in fact, just the opposite can occur." The need for making a good impression, especially with one's boss, must be given due recognition by all who supervise, and it does not matter whether the culture is 'individualistic' as in the US, or the culture is more 'collectivist' as in Singapore where group approval and 'face' is very important. Peter Senge (1990b) made the point that "Ironically, by focusing on performing for someone else's approval, corporations create the very conditions that predestine them to mediocre performance."

Putting the best foot forward ...

We can achieve much more quality lessons in our schools if we make use of the more colleague centred approach of joint searching for ideas to raise quality. This is especially true for those occasions when the purpose of supervision is less the evaluation of the teacher but more the development of quality lessons in the school. When the immediate purpose of supervision is as William Burton and Leo Brueckner (1955) had recommended since a long time ago, which is co-operatively to develop favourable settings for teaching and learning, the colleague approach is more helpful. To assist school supervisors in carrying out conferences with teachers based on the colleague approach to supervision, guidelines are provided below for both the pre- and post lesson observation conferences.

The main recommendations in the following guidelines were tried out in a series of four structured sessions in which supervision conferences were role-played by sixteen heads of department who were attending a full-time leadership training course at the National Institute of Education. In each session four participants took turns to role-play supervision conferences based on mock-up lessons, and the whole group discussed the role-plays between one session and the next. Incremental learning was assumed to have been fostered among the participants in the process. The later role-plays had capitalized to some extent on discus-

THE PROFESSIONAL-COLLEAGUE APPROACH TO A SUPERVISION CONFERENCE

A QUALITY LESSON SUPERVISION CONFERENCE

TOWARD A QUALITY SERVICE IN CLASSROOM TEACHING.

Guidelines for a Pre-lesson Conference

1. Show respect for a fellow teacher. Even the most junior colleague is a self-respecting person with every right to our time and attention. Be humble.

2. Remind one another that quality learning can take place within the dynamic and complex process of classroom interaction only as a result of quality teaching. Quality teaching rests on a deep understanding of what can and will go wrong, how it might be corrected, and what could possibly be done.

3. Inquire if he expects to be able to make a difference in the students' learning. If the answer is 'no', then there is no point in continuing with the conversation. He needs retraining. If the answer is 'yes', then determine how much change does he expect to make, and what does it mean to him and to you, to bring about this change. What does it matter whether the students have learned anything from his effort? Is it, for example, for reward and recognition, trust and security, independence and power, or status improvement?

4. Ask questions about the lesson plan in order to raise awareness and expectations of a high standard of performance, and listen attentively. If a record of past lessons exists, refer to these.

5. Offer suggestions to stimulate the intellect, and seek agreement.

6. Give praise, even admiration to raise hope and confidence

7. Clarify the objectives, rationale, expected difficulties. Share a vision of a 'great lesson' in which all students have made substantial progress. It helps to share a vision if there is a common 'language' to describe the dynamics of a lesson.

8. Maintain a conversational two-way lateral communication. Some humour and informality will help.

9. Adopt a team-effort approach. With the suggestions that you have made, you share joint responsibility for the desired outcome of teaching.

A Lesson Observation

Record your observations and impressions systematically, based on the shared vision

We can achieve much more quality lessons in our schools if we make use of the more colleague centred approach of joint searching for ideas to raise quality.

Guidelines for a Post-lesson Conference

1. Arrange to sit in a position that does not make you look confrontational.

2. Create a relaxed, and non-threatening atmosphere by stressing that you will not be judgemental but instead will strive for joint problem solving.

3. Create opportunity for the teacher to express himself. Be mindful of his self concept. Allow for a natural tendency to 'attribute away a blame' but 'claim a credit'. Separate the person from the problem by focusing on fixing the problem and trust him to realize what his contribution to solving the problem is. Often, the need to receive negative feedback is not nearly as great as the need to give it.

4. Make use of his own points and perceptions. Paraphrase and show empathy, while not compromising on quality. Listen for the whole picture and the underlying issue, if any, and legitimize his concerns.

5. Do not raise too many points at once, and avoid putting any in the form of rhetorical questions. Present a 'problem' not as a personal inadequacy, but as a joint opportunity for providing higher quality professional service. It helps to elicit his feelings about the 'problem' first and then present options for joint consideration as it should happen in teamwork.

6. Focus on methodology and student effects besides content.

7. Avoid using repetitively leading words or phrases such as 'except that', 'but', 'now', which let you go on to say something you think might be unpleasant.

8. Give praise whenever the evidence calls for it. Be specific when using words such as 'good' and 'effective'. If you can also express admiration besides praise, you should.

9. Check constantly that you have not unconsciously drifted away from the colleague approach back to a hierarchical, authority-based one. The hierarchical approach can be identified by much fault-finding, telling, blaming, being judgemental and even talking down. A colleague approach is identified by mutual respect and deference for each other's professional expertise, lateral two-way communication, jointly taking responsibility for quality work, and team spirit. Your choice of words used and non-verbal behaviour during the conference will also reflect the particular approach you adopt.

An example of what you could say in a Post-lesson Conference

I admire your effort and your skill. I don't think I could have done as well as you have. Let's try to review this lesson together to see if there is any opportunity for us to strive for a higher level of quality teaching in our future efforts.

This is what I think the students experienced with regard to quality learning. What is your impression? (Guidelines for describing the students' experience of a quality lesson appear below.)

What can we learn from this experience?

What have you and I done well this time?

What shall we do differently next time, in our effort to provide quality teaching in the classroom?

Guidelines for describing
THE STUDENTS' EXPERIENCE in quality learning

STUDENT EXPERIENCE	DESCRIPTION
Engaged in LEARNING at an appropriate level: • Of child development • In the taxonomies of learning objectives (cognitive, affective, and psychomotor domains)	• Active listening • Independent thinking while working at a task • Participate in brainstorming • Practice, practice and practice • Not just being led through an activity or passively entertained
Experienced success	• Suggestions were valued • Responses to teacher's question were acknowledged • Contribution to class discipline was appreciated • Task was completed satisfactorily • Progress made was recognized
Interested	• Discovered meaning • Coped with a challenge • Sought to cooperate with others • Enjoyed the company of friends

sions of the earlier role-plays. As insights grew from the discussions and observations of role-plays, the recommendations contained in the following guidelines were revised. In this respect, the author is indebted to the following heads of department for having helped to try out various aspects of these guidelines and made valuable suggestions: Au Sau Kheng, Mary Charles, Cheah Chye Keat, Chia Chiang Soo, Chin Jen Fu, Chang Weng Fatt, Foong Yin Wei, Lee Kong Wee, Wong Siok Eng, Leong Yoke Choy, Sum Kam Fong, Linda Ti, Ng Puey Koon, Seow Teow Seng, Tong Cheo Beng, and Yeo Kim Lian. The author is also grateful to Dr Chong Keng Choy who had made valuable comments on part of an earlier draft of this paper.

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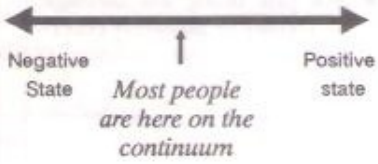
KATHERINE YIP

A Look into the Psychological Wellbeing of Secondary School Students

Whether it is adults or students, it cannot be denied that a person's performance is very much related to the individual's psychological wellbeing. We have all experienced times when we were under extra stress, and we may have even noticed that we were less energetic during that period, thus affecting our level of activity in general.

The Concept of Mental Health

A person's psychological wellbeing, or state of mental health, is reflected by a point on a continuum, with extremes at both ends that represent the positive and negative. However, since human beings are affected by circumstances one would expect this point to shift. At times the state of one's mental health could be more on the negative end of the continuum due to adverse circumstances while at other times the state of one's mental health could be more positive. The simple illustration below clarifies this concept.



Mental health can also be understood in terms of absence of mental illness, as well as one's ability in coping with the stresses encountered in daily life.

A Survey of the Needs and Problems of Secondary Students

In order to establish what are some of the worries, needs and problems of adolescents, a survey was administered using the Adolescent Counselling Inventory (ACI). The ACI was designed and normed by the author in collaboration with another colleague, Dr David Throll. The first survey was administered in 1990 on a sample of approximately 2000 secondary students representing a range of abilities from all ethnic groups. Another survey was done in 1992 on a sample of approximately 700 secondary students from a typical neighbourhood secondary school. The findings from Survey I were very similar to those from Survey II, that is

- the nature of the problems experienced by the boys were about the same as that experienced by the girls in both surveys
- the intensity of their problems were almost equal for both sexes
- in both samples, the more able students (from Express and Special courses) experienced greater stress in the area of schoolwork and exams
- in both samples, students from the

The nature of the problems experienced by the boys were about the same as that experienced by the girls in both surveys

Normal course appeared to get along better with their classmates (this is probably due to the fact that these students did not view their classmates with such a competitive eye and hence did not perceive them as academic rivals).

More specifically, the anxieties and problems of secondary students are reflected in the statements listed below. Regardless of gender, ethnicity, ability stream or grade level (Sec I to Pre-U III), the majority of students indicated "Always" or "Usually" to the following statements:

1. When I do poorly in class it spoils my day.
2. After tests I worry about my results.
3. I get upset if I don't do well in tests.
4. I don't like making mistakes.
5. I would like to be more confident within myself.
6. I wish I could face problems with more confidence.
7. I would like to have more friends at school.
8. People can let you down.
9. People can put a lot of pressure on you.
10. I don't know enough about jobs.
11. I can't think of any career that I will like.
12. I'm not sure of a bright future in a job.

A closer examination of the above statements will indicate that our students face problems in a number of areas - schoolwork, interpersonal relationships, career and confidence - and this affects their mental health.

Implications and recommendations for the classroom teacher

A number of implications are immediately identifiable:

1. Some time must be spent in class to speak to students about their concerns, as well as to establish rapport with them so that students will approach teachers with their worries or problems. This is best done through the pastoral care programme which has been implemented in most secondary schools.

2. The classroom atmosphere can be made less threatening so that students will perceive their classmates as collaborators in the learning and building up of each others' knowledge, rather than as competitors for top marks from whom they should withhold knowledge.

Collaborators

3. There should be recognition for effort, and affirmation of students as unique individuals with their own contribution to society that no other person could replace. Too often rewards and awards are given to top performers, the very few out of the hundreds in every school. If students are made to feel that they count and that their contribution is also part of the overall mosaic of school life and success, then confidence is strengthened as each student realises that he or she is essential in making the school what it is.

4. Students should be counselled that achieving academic excellence is important but just as important is the pursuit of a balanced, adjusted lifestyle, one in which there is time for others, to learn to socialise and to get along with people. In addition students should be made aware of the need to set realistic personal expectations so as not to frustrate themselves or put themselves under excessive stress.

Teachers must spend time in class to speak to students about their concerns, as well as to establish rapport with them so that students will approach teachers with their worries or problems.

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PAUL DEHART HURD

Why We Must Transform Science Education

Integrated science curriculum must reflect modern content that teaches higher-order thinking, "learning to learn" skills, and the uses of science in human affairs

When today's students complete their schooling, many of them will be functionally illiterate, unprepared to participate in or guide our science- and technology-oriented society. This situation, though bleak, is hardly surprising. More than 200 national reports on science education have described the current curriculum as obsolete. "In a great many cases, precollege education in the past decade has been literally perpetrating a fraud on the younger generation," observed D. Allan Bromley, science adviser to President Bush (Bromley 1989).

Perspectives for changing the science curriculum are taking shape. There is agreement that the present curriculum is indefensible; that science courses must reflect the ethos of modern science and technology; that instructional goals should focus upon the welfare of individuals and societal needs; and that reform is needed to prepare students for the 21st century. Here's what we must do.

Integrate the Disciplines

Science today is characterized by some 25,000 to 30,000 research fields. Findings from these fields are reported in 70,000 journals, 29,000 of which are new since 1978. Traditional disciplines have been hybridized into such new research areas as biochemistry, biophysics, biogeochemistry, and genetic engineering.

Science has changed in other ways. In this century, science and technology have merged to become an integrated system. When physicists discovered the laser, for example, technologists soon used it to develop tools for bloodless surgery, to create a laser disc for recording music, and to invent a device for reading barcodes on items at check-out counters in markets. In the biological sciences, findings from research in biotechnology are likely to reshape social and economic forces throughout the world in the next century.

These changes in the way modern science is organized have yet to be reflected in science courses. There is little recognition that in recent years the boundaries between the various natural sciences have become more and more blurred and major concepts more unified (Neurath et al. 1955). Greater integration of school subjects can provide a partial solution to this problem (Henry 1958).

Modernize the Content

Another problem with today's science curriculum is its outmoded content. Traditional courses reflect the theoretical structure and historical development of discrete disciplines, such as biology, chemistry, earth science, and physics. Each course seeks to convey the structure of an isolated discipline for the sake of understanding that discipline. Courses are not in close touch with human experience. As a result, the subject matter of traditional science courses is functionally inert outside of class.

One direction for reform, therefore, is to bring modern science into the curriculum. Recent social changes have brought about new dimensions to the question of what knowledge is of most worth and what its cultural context should be. The authors of *A Nation at Risk*, for example, recommend that science courses give attention to the "application of scientific knowledge to everyday life and to the social and environmental implications of scientific and technological development" (Gardner 1983).

Compared with traditional notions of science, modern science is driven more by societal needs than by theory. Thus research is channelled largely to human and social ends, such as finding a cure for AIDS, developing new energy sources, improving food production, developing communications systems, or deter-

mining public policy. The result is a complex of interacting relationships among science, technology, society, education, and human affairs.

This tie between science and social concerns has led some to propose the concept of developing human resources as a theme for science teaching (Carey 1990). The implication for curriculum development is a selection of knowledge from the sciences and technology related to social concerns, personal development, and the common good.

Teach Higher-Order Thinking

An additional problem with the science curriculum is its emphasis on preparing students to practice science as researchers, a central goal of precollege science education throughout history. This model persists because precollege teachers themselves have been taught this way for generations.

With a little training in something called "the scientific method", students - including those in elementary school - are expected to be able "to think like a scientist." Yet the method portrayed is largely unknown in the scientific community. Traditional science courses have taught thinking as a professional skill of scientists, with the assumption that there is a single "scientific" method of thinking. But the tens of thousands of research fields in modern science suggest there are multiple ways of thinking about science and technology problems. Patterns of thinking shown by researchers in physics, ecology, cognition, molecular biology, and computer science, for example, differ in style and vary with the investigation and the investigator.

Students of science and technology clearly need higher-order thinking skills. These skills are qualitative and related to processing and using information in ways that suggest a path for effective action. In science, such skills are needed for dealing with a whole range of social and human problems - for example, fostering the environment to enhance human survival and the quality of life. By contrast, traditional science courses confine whatever problems are dealt with to those of specific research fields.

Changes have made "learning to learn" an imperative in science education.

When science knowledge is applied to human affairs, many complex issues are raised: values, ethics, probability, policy, preference, limitations of the knowledge base, trade-offs. Alternatives must be weighed, risks assessed, and evidence confirmed or refuted. To channel knowledge from the sciences and technology to human experiences, students must be able to question the validity of knowledge from these sources. They must learn to distinguish theory from dogma, probability from certainty, fact from fiction, science from myth and folklore, and the limitations of science and technology in personal and social contexts. Higher-order thinking is critical to making such distinctions.

Use Better Texts, Less Jargon

Yet another problem with the science curriculum - closely connected with the "think like a scientist" criticism - is the overload of strange words students are required to learn. They are expected to grasp the technical terms, equations, formulas, and isolated facts that scientists use to communicate with fellow researchers. In a typical science course today, students encounter three to five new terms per day - words they have never seen before, never heard pronounced, and likely will never use again after Friday's test.

Science textbooks are among our most beautifully illustrated dictionaries. Some high school texts exceed a thousand pages of information, mostly facts. But, even if students were to know all the data ever discovered in the sciences, they would still be described as functionally illiterate. Scientific literacy is more than knowing a bag of facts.

Teach for Change

The rapid transformations occurring in the sciences and technology - and in all aspects of our lives - make recognizing and dealing with change a new goal of science teaching. Science and technology are the very bastions of change, offering "endless frontiers." The pace of change in the sciences doubles the amount of new knowledge every decade. Most technology becomes obsolete within five to seven years, faster in electronic fields.

Our culture, too, has changed in ways that must be considered in reforming science teaching. The socializing forces shaping the ideals, values and lives of young people today are not the same as those of two decades ago (Feldman and Elliott 1990). Problems of health, early pregnancy, drugs, suicide, a rampant homicide rate, the breakdown of the traditional family, and an apparent decline in motivation to learn cannot be neglected in reshaping science education.

Economic changes also deserve consideration. Since mid-century, the health of our economy and that of other developed countries has rested on our capacity to generate new knowledge, especially in the sciences and technology. Knowledge has replaced brawn, land, and other natural resources as the leading factor in determining our gross national product. Hence, our students will need to know more and work smarter

than any past generation. Not surprisingly, support for an economic goal for science teaching comes primarily from business and industry (Hurd 1989).

The sum of all these changes has made "learning to learn" an imperative in science education. This perspective seeks to provide students with the capabilities to renew and sustain their education throughout life. Developing learning skills alone will not accomplish this objective, however, without a science curriculum in which subject matter is selected for its generalizability in human experiences. Traditional discipline-bound, fact-laden science courses are too narrow in scope to do this.

To change the perspective of science instruction from a historical one to a focus on "learning to learn" projects a future context. The goal is not to predict the future, however, but to use what we have learned to plan and direct the future. For example, to achieve a high quality of life, a favorable environment for human survival, sustainable sources of energy, physical and mental well-being and longevity requires planning throughout one's lifetime.

Inventing the Integrated Curriculum

Despite the turmoil over the science curriculum during the past decades, not much has happened. The changes that have been made - higher graduation requirements in science, longer school days and school years, more hands-on activities, improved testing, and more rigor - are well intentioned but have little to do with modernizing the curriculum. In fact, changes have done more to stabilize an obsolete curriculum than to provide insight and guidance for realizing a new vision of science teaching (Hurd 1984).

What has stalled the curriculum reform movement is the lack of a coherent vision of what an education in science for effective citizenship should be about, and what every citizen should know. The reform movement of the 1990s calls for an integration of school subjects: a conceptual convergence of the natural sciences, mathematics, and technology with the social and behavioral sciences and the humanities into a coherent whole. A unity of knowledge will make it possible for students to take learning from different fields of study and use it to view human problems in their fullness from several perspectives.

Breaking out of the intellectual strait-jacket and nostalgia that characterize traditional science courses will not be easy. We must start from scratch. Little will be gained by simply revising and updating old subject matter, tinkering with the instructional system, modifying assessment techniques, or reorganizing institutions.

Transforming science teaching so that students graduate with scientific literacy requires that the natural and social scientists, behavioral scientists, teachers and other educators - along with representatives from the humanities and the philosophy and sociology of science- sit down together, in a spirit of good will and mutual respect, to determine what citizens should know for living and participating in our science- and technology-oriented society.

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ISSN 0218-2491