Bridging in Both Directions

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Introduction

The following diagram, originally presented by Malcolm Knowles, describes the situation challenging education today.

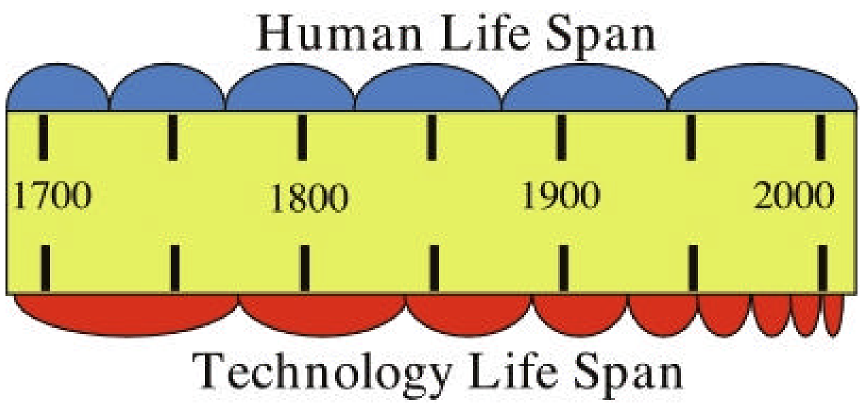

Figure 1. Changes in life spans -- humans and technologies.

Human life has been getting longer until now, in the developed world, on average people live twice as long as they did three centuries ago. At the same time, the lives of technologies grow shorter. Anyone who uses computer software is painfully aware of how rapidly technologies are changing. We, the adults, cannot keep up. According to Figure 1, the demands will be even greater for our children. Given this situation, what shall we teach?

Some people believe they know the answer to the question "What shall we teach?" In my country, and in several others, there exist committees of the government and private organizations, preparing lists of what children should know by the third grade, the sixth grade, the eighth grade and upon graduation from high school. These lists seem to agree, at least superficially, on such topics as:

> **Language arts**, including reading, writing, listening and speaking in ways that were agreed upon a century ago. *There is less agreement, however on whether writing includes computer communications, e-mail, graphics, including motion, or video, which are likely to become commonplace by the year 2010. Does reading include browsing the Internet?*
>
> **Mathematics**, including arithmetic, geometry, trigonometry, algebra and calculus. These too were identified at least a half-century ago. *There is less agreement on teaching the use of calculators, computers, numerical methods, computer simulation and data analysis, already in use regularly on the Internet.*

> **Science**, including physics chemistry and biological sciences. These topics have been updated to cover what was known about a quarter century ago. *There is less agreement on such topics as the genome and genetic modification.*

Marion Brady has written a little book in which he discusses the mismatch between the needs of our children and what we generally include in our schools today[1]. Among other things he observes:

1. Knowledge is expanding at an ever-accelerating rate, and the rapidity of social change has never been greater.
2. Our best minds tell us that all knowledge is related, yet our curriculum is fragmented and the fragments are moving farther apart.
3. The proper subject matter of education is reality.
4. A defensible general education curriculum will be demonstrably applicable to daily experience.
5. The learning process requires that new information become part of a coherent conceptual structure.
6. Perhaps most important of all, the learning process requires that new information become part of a coherent conceptual structure. He maintains that our "natural" approach to organizing and systemically integrating knowledge, not the traditional academic disciplines, provides the optimum conceptual structure.

Brady's solution to these conflicts is to just throw out the required curriculum and teach children to investigate, analyze and organize information about what is going on in their lives and in their society. In the process, he argues, the children will learn to read, write, do mathematics and will learn the rudiments of science and technology.[2]

My point is that when we look more closely at what the committees of experts suggest, it becomes clear that they do not know what to teach to prepare our children for *today*, let alone know what to teach for tomorrow. Whatever we decide to include in the curriculum, it will not be enough. There is no way we can equip our children with the knowledge they shall need in the future. We need to adopt a philosophy which is vastly different from the one which shaped our schools and our current vision of what education is all about.

All over the world governments are taking a closer look at education. Wise leaders recognize that education must change. The present educational system was designed for a different era. It was designed to prepare children to live in a world not too different from the one their parents inhabited. Even today most schools concentrate on teaching children the answers to questions their elders think are important. This no longer suffices. While we, the adults, struggle to find answers to today's questions, we should be

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[1] Brady, Marion What's Worth Teaching; Selecting, Organizing and Integrating Knowledge Suny Series in Philosophy of Education, Sate University of New York Press (1989)

[2] Marion Brady's approach is discussed in greater detail in Appendix A.

providing our children with knowledge useful for *their* futures. Our problem is that we do not know what to teach. We do not know the answers to tomorrow's questions. Indeed, we do not even know the questions! What then should we teach the oncoming generations? How should we teach?

However we decide to restate our objectives in education, one thing is clear: Our children must become prepared to be continual learners. We must equip them with a sense of joy in learning and prepare them to become autonomous, self-directed learners for the rest of their lives. We need to establish new criteria for what we teach and how to teach it. We need to equip the next generation with the ability to approach new situations, figure out what they need to learn, to plan their own learning and to apply what they learn, all the while finding satisfaction and joy in what they do.

A Solution to the Dilemma of "What to Teach"

If we were preparing people to traverse a wilderness, we would not try to equip them with all the food and water they needed for the journey. Instead we would teach them how to hunt, how to fish and how to find water. We would give them some materials to get them started but we would expect them to rely upon themselves for survival.

In education we should adopt a similar policy, teaching the next generation things they are likely to find useful, interesting and enjoyable at the start of their journey but teaching them in such a way that we develop in them the ability to learn new things. In other words, we should develop their ability to be independent learners. We should equip them to learn how to learn.

With this policy the details of what they learn in school will become much less important. We can provide them with whatever skills and knowledge seem most important at the moment, but our aim should be on the future. The *method of teaching* should be directed at creating learners for life. Fortunately, through Reuven Feuerstein's theory of Structural Cognitive Modifiability (SCM) we know how to do this. Through SCM it is possible to teach in a manner which develops an ability to learn any other subject. The breadth of the education will be decided, not by the curriculum, but by the way the curriculum is taught.

Through Feuerstein's SCM children can be prepared to teach themselves, to take charge of their learning and translate this learning into practice. To achieve this objective will require a significant overhaul of the entire educational system. To begin with, the relationship between teacher and learner will have to change. The teacher's *self image* will need to be transformed. The way the curriculum is designed will change. The way the institutions of education are governed will change. The methods of evaluation of effectiveness of education will change. I cannot promise that these changes will be easy, for changing education is a most difficult business. But I can say that the changes are essential for our children's survival.

Transcendence -- a Unique Human Ability

Humans are unique in their ability to have an experience in one domain of life, to extract lessons from the experience and then to apply those lessons to an entirely different domain of their existence. Many animals can be trained to respond to a given situation. But humans are alone in their ability to draw a lesson from an experience in one time and place, transmit to their progeny the lessons learned and see their progeny apply these lessons in a new time and place. We call this *transcendence,* the ability to transcend time and place. Meir Ben-Hur has developed a diagram to illustrate this process, from which the following figure has been adapted.

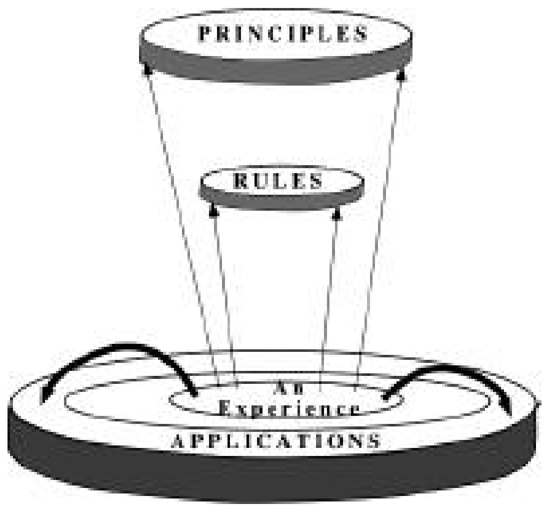

Figure 2. Abstracting rules and principles from experience.

Human brains are equipped to examine an experience and then branch laterally to a different application and apply similar tools and concepts. Once a child has learned to hammer a nail, the child can figure out how to use the hammer to pound on other objects. These lateral transfers are relatively easy to learn. They will occur faster if an adult shows the child how to do it or to recognize slightly different applications of the tool or concept.

Good parents teach their children to develop rules of behavior from experience. They teach about fair play, about sharing of possessions, about respect for others. Parents, in general, are less able to show their children how to extract principles from experience. The reason that mathematics and science are accorded such a fundamental place in education is that mathematics and science are devoted to the discovery of broad generalizations and principles. Think of the principle of conservation of energy or of matter as examples. Think of the Theorem of Pythagoras as another example.

The principle tool for the interpretation of experience is *language*. One generation passes its knowledge to the next through language. This is why, in all considerations of the curriculum, <u>language, science and mathematics</u> occur at the head of the list of topics to be taught. In his monumental study of the role of language in human cognition, Korzybski[3] repeatedly makes the point that the structure of language shapes the structures of our thoughts. In the application of Feuerstein's SCM precision of language plays a central role.

The conventional approach to the teaching of science and mathematics concentrates on the mastery of the *known* principles. Conventional teaching does not concentrate on the mental processes that lead to the discovery of new principles. Conventional teaching in science and mathematics concentrates on lateral branching, that is, on how to apply these principles to various problems. They show students how to apply their scientific and mathematical hammers to different problems.

The theory of SCM, on the other hand, properly applied may be used to equip learners with a deeper understanding of the process of extracting rules and principles from experience and thereby equips the learner to develop new tools, new hammers, if you will. SCM is the basis for providing a different form of education.

The lessons learned from experience appear in our brains in the form of neural structures, that is, as relatively persistent connections among neurons. If these structures have been properly formed, we may use them over and over again in new contexts. The key phrase here is "properly formed". A child, left alone to discover the rules and principles of nature, will not benefit from the accumulated wisdom of his or her culture. A human must intervene.

The process whereby one human helps another to draw the deeper lessons from experience is called Mediated Learning Experience (MLE). MLE describes how one person (usually, but not exclusively, an adult) helps another person (usually a younger person, but not exclusively) to interpret their life experiences and to draw from them rules and principles useful in another time and place. MLE also includes helping the learner "bridge" to other applications and to recognize the meaning of the rules and principles. The advantage of formalizing this process, MLE, is that now MLE can itself be analyzed, improved and most importantly, taught to others. Because MLE has been discussed in so many other publications from the International Center for The Enhancement of Learning Potential in Israel, I shall not dwell longer on it here.

The Trap

It has been my experience, and I know it is the experience of many others, that when teachers first begin to practice MLE, it feels awkward to them. There is a difference between teaching and mediating:

> Teaching is concerned with having students master a subject. The students demonstrate their mastery by what they say about the subject, how they solve problems posed in the subject and by showing skill in

[3] Alfred Korzybski, Science and Sanity, (5th edition)1994, Institute of General Semantics, Englewood, New Jersey, USA

> using the tools and methods associated with the subject. Teaching presumes the intelligence is already developed and that mastery of the subject is the main goal.
>
> Mediation is concerned with having students master their own thinking processes. The students demonstrate this mastery by showing an awareness of how they organize their thought processes, how they use their intellectual resources to acquire, organize and analyze information, how they develop strategies for controlling themselves as they encounter challenges. Mediation looks upon the development of intelligence as the main goal and as intelligence is developed, teaching goals will be met.

I find three definitions useful here:

> ***Teaching is concerned with product; mediation is concerned with process***.
>
> ***Intelligence is what you use when you do not know what to do.***

The teacher using FIE needs to keep Meir Ben-Hur's diagram (figure 2 above) in mind at all times. The objective is NOT to gain skill in "doing the dots" (though that will come) but to gain awareness and mastery of what the learner is doing with his or her brain. The objective is help the learner to develop rules and principles based on the experiences of the learner. The objective more than just developing rules and principles; the objective is to make the learner (and mediator) *aware* of the processes whereby they develop rules and procedures.

Bridging

As was said earlier, the ability to transcend the moment is a unique human ability. We call this ability to transcend "bridging", analagous to the building of bridges from one shore to another. In the context of creating learners who know how to learn, bridging becomes the essential measure of successful education. The educated person is one who can see how different areas of knowledge connect; who sees a unity in knowledge.

If you want students to become continuous learners when they are adults, it is well to remember the slogan: "Rigor, relevance and fun". Whatever you ask students to do, they should have that existential pleasure that comes from doing something right, knowing they have done it right, and being able to prove to someone else that they did it right and with style. Whatever you ask students to do, they should be able to see it as relevant to their own goals. They should understand the meaning of what they are doing and they should see that gaining competence is in their own self-interest. Finally, if you want anyone to do something willingly, it should be fun to do. There is no hard and fast rule for bridging to what is relevant and fun; that will depend upon the learner. It is up to the teacher's ingenuity and knowledge to create this sense of relevance by proposing ways to bridge to other areas of life and to draw examples of bridging out of the student's own experience.

The following diagram has been developed to help mediators and teachers to analyze tasks and see better how to create bridges. The diagram is equally applicable to mediation of experiences provided by Feuerstein's Instrumental Enrichment (FIE) and to conventional courses in a curriculum.

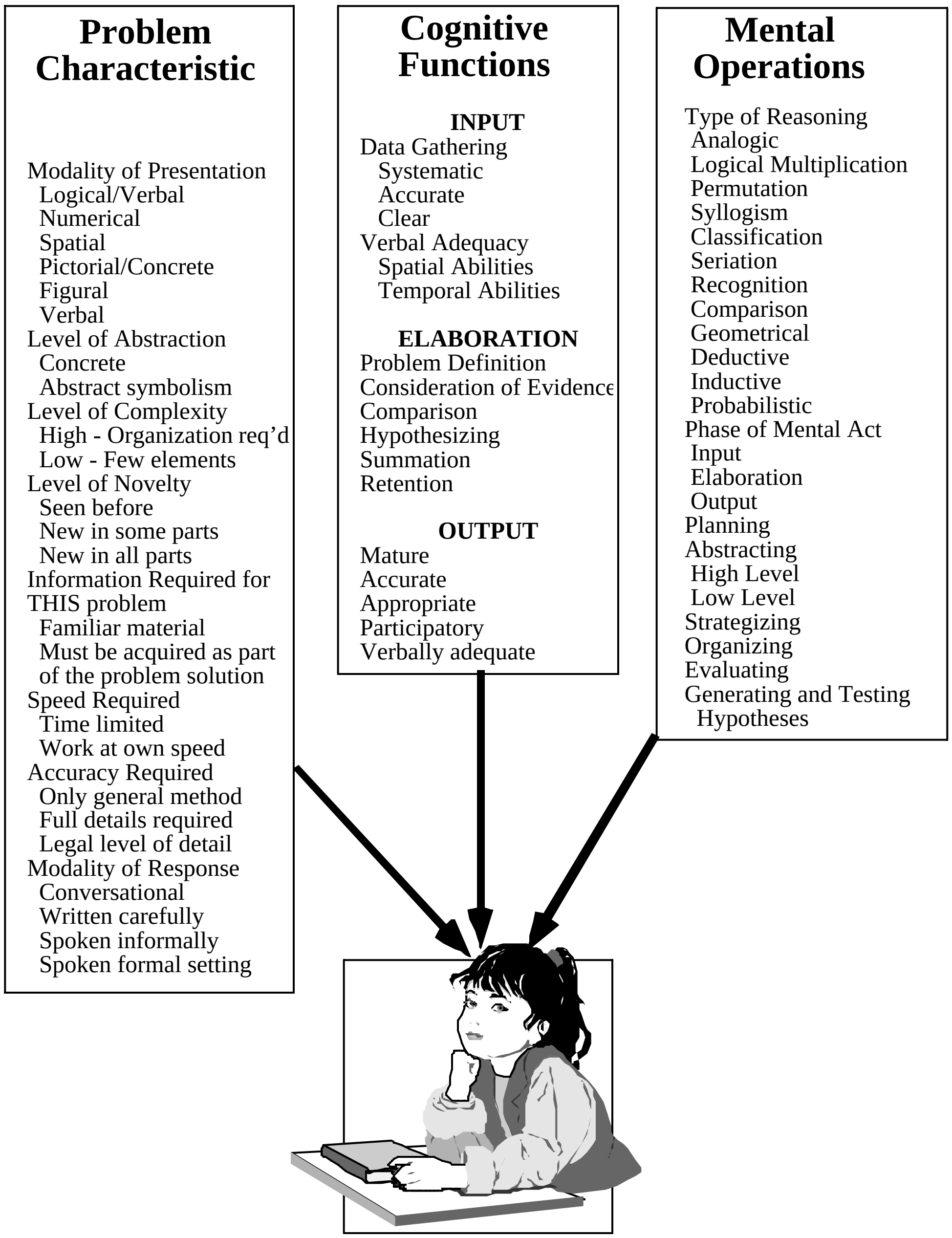

Figure 3. Elements to consider when bridging

The left column of figure 3 describes the attributes of the challenge facing the learner. If any of the characteristics of the task becomes significant to the learner, either by way of causing difficulty or a sense of achievement, the mediator can search for examples of other circumstances in which this attribute plays a part. For example, if the task on which the student is working requires a relatively high level of abstraction, the mediator should point out that when if the learner wishes to fly an airplane, the same level of abstraction will be required. Learning to develop a script for and shoot a video production also calls for a high level of abstraction. If a problem has to be done in a short time, the mediator can call attention to sporting events which require rapid solution of problems. If the given problem involves a mixture of modalities, the student can be reminded that in many mathematics classes the main problem is to translate from a "word problem" to an algebraic statement to a numerical answer.

A particularly important aspect of any problem is the level of abstraction required in achieving a solution. Korzybski devotes an entire chapter of his book to the notion of *abstracting.*[4] Students need to understand the process of abstracting and appreciate the concept of *level of abstraction.* Through abstraction we are able to create concepts of greater and greater applicability. Bridging to new applications depends upon generalized concepts. When students use these generalized concepts they should be aware of what they are doing, otherwise they will just be mechanically following formalism with no understanding of what they do.

This bridging by the use of the characteristics in the left-most column of figure 3 can provide greater *meaning* to the learner and increase the sense of relevance.

Bridging by way of Rules for Behavior

The middle column in the above diagram is concerned with the way the learner approaches the task and, as such, is so general as to apply to almost any other problem. If the learner recognizes the need to control his or her impulsivity, the mediator can ask, "Where else has this been a problem for you?" and rely upon the learner to suggest examples. If the learner recognizes the need for a better strategy, the mediator can ask, "Where else do you think you might need to think about the strategy you use to approach a problem?" Again, the learner and mediator should explore the learner's life experiences, looking for instances in which strategic planning has been, or will be important.

When bridging by use of cognitive functions, it is especially important that the learner be *aware* of what is going on. The mediator should develop in the learner a *felt need* to be aware of the cognitive functions and to use them <u>in a knowing way</u> as often as possible. Thorndike's laws of learning, developed in the early part of the last century, describe the strengthening of skill through use and the loss through disuse. Modern brain research provides additional evidence by showing that when a neurological structure is used over and over again, it becomes coated chemically and requires less energy to use.

The key to success in this kind of bridging is to develop the learner's awareness of what is happening in his or her own brain.

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[4] Korzybski, ibid pg. 371

Bridging Via Mental Operations

It is when we come to the third column that bridging to specific academic subjects becomes more of a challenge, depending upon the knowledge and background of the mediator. I can only give a few examples from my own experience.

By way of an example, I always spend time in the instrument, Organization of Dots, discussing the role of the word "Organization" in the title. It comes as a surprise to students to realize that the constellations reside in their heads and are not "really out there". This very basic concept, that the brain constructs models of reality as a way of making sense out of things is worthy of considerable discussion. Here are some of the areas I have found useful:

> We organize our understanding of atoms and molecules through the use of the periodic table of the elements.
> We impose the concepts of "liberal" and "conservative" on people.
> We invent names and impose them on the behavior of people ("shy", "outgoing", "show-off", "quiet", etc., etc'.)
> We invent and name football plays.

In general I try to get students to generate examples and then, using their examples as a basis, investigate how their particular system of organization got started and why. The theme that binds all of these examples together is the brain trying to make sense out of the information that comes to it. I try to make explicit the process of organizing information and dispel any tendency to approach organization of knowledge as a passive recipient of what has already been done.

In Analytic Perception, I consider the processes of breaking a whole into parts (analysis) and putting the pieces together (synthesis) as universals and therefore, again try to get the students to generate examples. Possible candidate topics for this exercise include:

> Analysis of a recent movie, a video show or an advertisement.
> (Plot, character, theme, setting, mood, action)
> Synthesis of the above example to improve it.
> The field of social studies abounds with attempts to analyze human society by separating it into components such as legal, political, economic, religious, private and governmental "sectors". This area is rich in the potential for conversation about what gets lost when societies are analyzed in this way.

In Comparisons, it is very easy to find examples.

> Shopping in a grocery store to select foods. On what basis do we make the selection?
> Career choices. Select several possible careers and compare them as to time required to master, salaries, and psychological rewards.

> Ask the learners to provide examples from their homework in which they are asked to make comparisons. (This is often an assignment in a literature class or a social science class asked to compare cultures.)

In Orientation in Space, an interesting way to bridge to something in the student's interest is to have one student be blindfolded and obey the detailed instructions of another student in navigating around an obstacle course (such as provided by the furniture in a classroom). Let the students make up the 'rules' (i.e., stop when at an obstruction, walk very slowly, etc., etc.) Other significant examples come from science:

> Show a picture of an astronaut standing on the Moon, looking back at Earth and ask the question, "Which way is down?"
> Discuss how an airplane pilot knows which way to fly. How does the pilot know the answer to "Which way is up?"

In Temporal Relations divide the students into pairs. Let one of them close his or her eyes and silently judge when one minute has passed. The other student should look at a watch and record the actual elapsed time. The students should then change roles. Afterwards make a graph of the different results and use this as the basis for a discussion in the class.

> Discuss the difference among time as measured by rotation of the earth and as measured by the vibration of cesium atoms. Trace the history of the development of time (sundials, pendulum clocks, chronometers, 'atomic' clocks)
> Discuss the importance of time in navigation. The role of Greenwich time in knowing how far a ship is East or West.
> Discuss how the GPS system works, measuring the time for signals to come from more than one source.

In Family Relations ask the students to prepare their own genealogical trees. Use both names and labels, follow the conventions of the instrument (squares for male, circles for female).

> Discuss the similarities and dissimilarities in treating computers as "families" by virtue of their designs. Is this a legitimate use of the word "family"?

In Categorization ask students to list the categories under which music is classified. Ask for examples involving their own preferences from radio, movies, TV or their own records or tapes. As for clear definitions of each category -- what distinguishes one kind of music from another? How do they know into which category to put a particular example?

Categorization occurs in just about every academic subject. It is another example of imposing an organization on knowledge. Every branch of science uses categorization.

Psychology -- personality types
Philosophy -- according to authors
Chemistry -- periodic table
Physics -- Electromagnetic fields, fluid fields, solids
Biology -- Types of plants, types of animals
Economics -- Free market, controlled, socialist

In Numerical Progressions the objective is to learn to recognize and render explicit patterns in either space or time. If there have been recent local difficulties due to drought or to excessive rain, obtain from government sources (or the library) records of weather in your region for the last several years (usually month by month, or week by week). Ask the students to plot the data in the form of a run chart and to look for patterns. Ask them to make projections one week in advance based on the data they have accumulated.

When the students are involved in Syllogisms, obtain copies of political speeches and select key statements. Ask the students to analyze them based on syllogistic reasoning.

In Instructions divide the students into pairs. Give one student a geometric figure involving several different shapes, laid over one another and with different orientations. Ask the student to instruct the other student (without showing the figure) in such a way that the other student reproduces the figure. After the exercise, compare the instructions given, looking for most elegant set of instructions (that is accurate, short and easy to follow). Based on this experience, let the students change roles, supply a new figure and see if the instructions generated the second time are improved. Discuss the rules for making good instructions.

When working with Illustrations, collect political cartoons from newspapers and ask the students to analyze them.

Using MLE in the Curriculum

The instruments of Feuerstein's Instrumental Enrichment have been designed to provide the experiences most easily mediated. They are not linked to any special subject in the curriculum and each instrument has been designed to help strengthen a cognitive function. The majority of the student's time will be spent in classes which are aimed at teaching something specific. In these circumstances it is tempting for the instructor to fall back on the accustomed role of teacher, mistakenly thinking that mediation belongs with FIE and teaching is required in the curriculum.

When we use MLE with the curriculum, we are bridging back from a specific application to the fundamental ideas of FIE. There is one fundamental difference, however. In FIE he mediator is constantly inquiring and observing to see if the student has a weakness in cognitive functioning. In the curriculum, the teacher has first of all the aim to see that the student masters the topic of the class. The discussion of the topics shown in figure 3 should be used to further the aim of the course, not divert it. Meir Ben-Hur has written about this potential conflict in the following way:[5]

> "A teacher must first decide whether a student needs mediated learning. If mediation is not needed, then it is useless and may even be harmful. Mediation, by definition, replaces independent work. If a student has formed an appropriate goal for his or her science observations (i.e., has formed a relevant hypothesis); can follow written directions; can record, compare and sort data; can write a report; and can present findings, and if his or her learning requires only these processes, then mediation is not needed. If the student cannot perform one, or more, of these functions, then mediation should be offered to ameliorate the specific deficiency. Furthermore, mediation should be withheld as soon as the student achieves mastery. Ultimately, all students should be able to benefit from all types of learning opportunities, including direct learning experiences -- such as lectures, the internet, and independent study -- because they have learned how to learn."

The diagram of figure 3 is proposed for this use of MLE because it is my experience that when a teacher leaves the environment created by instrumental enrichment and enters the typical classroom, the teacher has difficulty deciding what to do when a student encounters a problem. It is all too easy to concentrate on just showing the student how to solve the problem. That's teaching. When the instructor helps the student become more conscious of his or her own mental processes, that's mediation.

Starting with the problem statement itself, the teacher can examine the left column of figure 3, looking for the basis of the difficulty[6]. If information is required and the student does not realize it, then the mediator should move into the teaching role, and either supply the missing information or direct the student on how to acquire it. It may be as simple a matter as a definition.

By observing the phase of the activity (input, elaboration or output) and by asking questions, such as, "How are you approaching this?" or "What is your strategy?" the mediator can gain insight as to which cognitive functions require strengthening. Together the learner and mediator can examine the list of mental operations to see if the student knows how to perform the required ones.

In this interaction the mediator is exploring what Lev Vygotsky has called the "zone of proximal development", that is, the region in which the learner is ready to learn. This calls for a delicate balance. The mediator gives a small amount of instruction in whatever the learner needs, then observes how well the learner receives it. When the learner

[5] Meir Ben-Hur, "Mediation of Cognitive Competencies for Students in Need" Phi Delta Kappan, May 1998, pp. 661-666

[6] If the student is mature enough, the teacher and student may look at the diagram together, using the list of topics as a way, together, to try to pin-point the source of difficulty.

appears to be grasping an idea, the instructor should immediately resume the role of mediator and help the student appreciate the meaning of what has just been learned. The mediator's cleverness will dictate the specifics of the interaction but whatever the interaction, the mediator should keep in mind that the objective is to make the learner aware of his or her own cognitive processes while at the same time mastering the subject matter.

Conclusion

Today students are taught in a curriculum based upon specialization of knowledge. They are given a jig saw puzzle without ever having the benefit of seeing the picture on the top of the box. They are entering a world in which the individual pieces no longer fit; new pieces must be acquired and old ones modified.

To be prepared for the new era, students must, above all, be taught to take control of their own learning processes. They must be helped to learn how to acquire new knowledge, organize this new knowledge and act upon it.

To achieve this aim teachers need to learn how to make connections among all branches of knowledge. Bridging from Feuerstein's Instrumental Enrichment promotes this skill among both teachers and learners. But Feuerstein's Instrumental Enrichment should not carry the burden, alone, of developing thinking skills. Every subject in the curriculum should be used to increase the students' awareness of their own thought processes. Only in this way will students become prepared for the learning challenges of their future.

Appendix A

The Essential Revolution
Marion Brady

The Aim of General Education

The primary aim of a general education is to help students construct conceptual tools that will permit them to continuously expand their understanding of individual and collective experience.

To this end our schools have fashioned organized bodies of knowledge--the academic disciplines. However, this system of organization is seriously flawed.

The Problem

Harlan Cleveland: "It is a well-known scandal that our whole educational system is geared more to categorizing and analyzing patches of knowledge than to threading them together."

Buckminster Fuller: "American education has evolved in such a way it will be the undoing of the society."

Neil Postman: "There is no longer any principle that unifies the school curriculum and furnishes it with meaning."

Mervyn Cadwallader: "(The general education curriculum) lacks coherence, integration, synthesis."

Jonathan Smith: "To dump on students the task of finding coherence in their education is indefensible. Colleges shouldn't be allowed to collect tuition on that basis."

Gordon Cawelti: "The traditional, separate-subject curriculum at the high school level is typically not based on the question of what knowledge is of most worth."

Philip Sabaratta:"Students rarely have an opportunity to discover what one set of ideas has to do with another set of ideas."

Mark Curtis: "The chaotic state of the baccalaureate curricula may be the most troubling problem of higher education."

David Cohen: "The U.S. does not have a coherent system for . . . articulating curriculum."

James C. Coomer: "Our educational systems . . . are now primarily designed to teach people specialized knowledge– to enable students to divide and dissect knowledge. At the heart of this pattern of teaching is . . . a view of the world that is quite simply false."

Frederick Rudolph: "The curriculum is like a bazaar, and students like tourists looking for cheap bargains."

Robert Stevens: "We have lost sight of our responsibility for synthesizing learning."

Daniel Tanner: "All of our experience should have made it clear by now that faculty and students will not derive from a list of disjointed courses a coherent curriculum revealing the necessary interdependence of knowledge."

John I Goodlad: "The division into subjects and periods encourages a segmented rather than an integrated view of knowledge. Consequently, what students are asked to relate to in schooling becomes increasingly artificial, cut off from the human experiences subject matter is supposed to reflect."

William H. Newell: "The problems now faced by our society transcend the bounds of disciplines. Their solution requires the breadth of vision and skills of synthesis and integration."

Leon Botstein: "We must fight the inappropriate fragmentation of the curriculum by disciplines."

Report of the Association of American Colleges' Project on Redefining the Meaning and Purpose of Baccalaureate Degrees: "The abundance of reports . . . prescribing for our schools and colleges, the urgency with which they are argued, the evidence that they summon, and the analyses they offer are persuasive evidence that there is a profound crisis."

Failure to recognize and respect the integrated nature of knowledge affects every aspect of schooling--instruction, staffing, finance, facility design, instructional materials, professional preparation, parental support, public perceptions--everything. Reforms that fail to address the problem of fragmented knowledge will be superficial or counterproductive.

The Solution to "The Problem"

1. To survive, humans must process information--select it, organize it, store it, retrieve it, manipulate it, expand it.

2. Effective information processing requires a system. We all have such a system. It has been used by each of us intuitively since childhood.

3. Our system has five "super organizers." Trying to make sense of information, the system says to us, "Find out who, where, when, what, why."

4. These five, *and the relationships between them*, are the most efficient and complete organizing system available.

5. To make the most of the system's educational potential, it must be brought into awareness and put to deliberate, formal use.

6. There are two main reasons we do not yet do this: (a) We are unaware that we have and use the system, and (b) we assume that another system, the one adopted in the 19th century that now organizes schooling, is the best system available.

7. Our natural system for processing information is superior to the familiar subjects and courses as an organizer because it (a) takes in all knowledge, and (b) makes all knowledge part of a single, integrated system.

8. Because knowledge expands only when relationships are discovered between things not previously thought to be related, making all knowledge part of a single conceptual framework is essential.

9. The artificial, arbitrary walls formal schooling erects around subjects and courses block perception of all except nearby relationships. Our natural system erects no such barriers. It takes in and relates all knowledge.

10. Raising into awareness our natural system for selecting, organizing, storing, retrieving, manipulating, and expanding information is the most efficient and effective means to the ends of general education.

The Curriculum

Sense is made of situations, problems, circumstances, conditions, events, or other experiences by locating them in an environment, assigning them time dimensions, identifying participant actors, describing the action, and attributing or assuming reasons for the action (where, when, who, what, why). These five, and their supporting conceptual substructures, encompass all knowledge. Their systemic relationships shape all experience.

This "master" system for processing knowledge is known implicitly by all students. The general education curriculum's primary emphasis should be on making the system explicit, familiarizing students with its role in selecting, organizing, storing, retrieving, manipulating, and expanding knowledge, and enhancing their ability to make deliberate use of it..

Present academic disciplines elaborate various aspects of this knowledge-organizing system. The curriculum should make clear the relationship of specialized studies to the whole of which they are parts.

Given the myriad variables affecting instruction, primary responsibility for the design of instructional strategies to operationalize the curriculum should be in the hands of the classroom teacher.

The Standard

Presented with complex, real-world situations, problems, circumstances, conditions, events, or experiences, students will be able to put them in historical, cultural and societal context, identify situation elements, speculate about element relevance based on systemic factors, generate plausible hypotheses to explain probable and possible situation causes and consequences, and suggest systemic changes that would differently configure the situation to achieve preferable consequences.

Accountability

Determining the extent, degree or quality of student achievement in relation to The Standard requires that students be presented with unfamiliar real-world situations, problems, circumstances, conditions, events, or experiences and required to deal with them in a manner consistent with The Standard.

Given the myriad variables affecting instruction, primary responsibility for evaluation of student performance should be in the hands of the classroom teacher. Such evaluation will of necessity be subjective.

Marion Brady, October 2000

For a more extended discussion of curriculum reform, see Marion Brady's home page: http://home.cfl.rr.com/marion/mbrady.html