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IMAGINE YOURSELF OCCUPYING a bed in a large ward of a publicly-supported general hospital. Early one morning, in walks a contingent of medical staff, including a chief, some residents, several interns, a couple of nurses, and an orderly. The chief calls for attention. "Folks, it's time for testing. Please swing your legs over the side and get ready to give us a urine sample. The orderly will distribute the containers."

The patients dutifully comply. The orderly passes from bed to bed, collecting the samples and placing them on a cart. You are amazed when he empties them all into a carboy sitting in the middle of the room. He shakes the carboy from side to side, then reaches in with a graduated beaker and extracts a generous sample. The entourage leaves.

Late in the afternoon, the chief of staff, accompanied by three senior physicians and some men in business suits, appears and again calls for attention: "Folks, the test results are back. Based on the ward urinalysis, the mean disease here is bacterial genitourinary tract infection. Therefore, starting tomorrow, you will each take 50 mg. of Macrochantin with every meal and again at bedtime. Fortunately, we have been able to purchase Macrochantin in a large quantity, so we are taking advantage of the substantial discount." The men in the business suits just smile.

This sounds reasonable until you remember that you have never had any urinary tract problems and are in the hospital for evaluation of abdominal pain late in your pregnancy, a condition for

which Macrochantin is definitely contraindicated. Would you be outraged? Of course you would. And yet, with only minor variations, this allegory describes the method by which educational decisions are made for millions of America's children every year. The only difference is that educators usually don't even bother to take the sample!

Now, let us extend the metaphor. You live in a society where, by law, you must spend a portion of every one of 180 days per year as a patient in this hospital. You will occupy a bed five days a week from early September until early June, with a week or two off for the holidays. At the end of this period, you will be promoted to a higher floor, regardless of whether there has been any change in your condition.

Patients on the higher floors have been in the system longer. Some of them are known to participate in interesting group activities for short periods away from the hospital. Occasionally, they wear uniforms and their activities are attended by large crowds of ordinary citizens. For a few who excel in these activities, opportunities await to perform them on a professional basis. However, most of the patients on the higher floors eventually leave and are never heard from again. Many disappear before their treatment is concluded. No one seems to know if they ever got better. No one seems to care.

Would a civilized society long tolerate a medical system that operated this way? Certainly not, but we tolerate an educational system which functions more

or less like our imaginary hospital. Students must, by law, participate in the system for a prescribed period of time. They are then either graduated or allowed to leave, often without attaining even the most basic levels of literacy. Large numbers of them are unemployable in any but the most menial of jobs. Meanwhile, concern grows that our standard of living is contracting and we are losing our position of leadership among the world's economies.

There is certainly no shortage of criticism of our educational system. Both the printed and electronic media regularly report the latest statistics. Blue ribbon commissions, Governor's councils, industrial groups, and even the White House sound periodic alarms. Major studies are commissioned, appropriations increase, and the situation grows steadily worse. Is our culture doomed to continuing decline because we can no longer educate our young to a degree sufficient to maintain or advance it? We think not.

Cultural practices change when their economic consequences finally become intolerable. The steadily increasing costs and decreasing benefits of our present educational system are beginning to force variation from which superior practices will be selected. Fortunately, some basic principles exist which will guide the selection process. The medical metaphor can be extended to outline these principles and suggest how they might be applied to accelerate the desperately needed change.

A PROVISIONAL DIAGNOSIS

Education is the process whereby the behavior of individuals called learners or students is changed as the result of exposure to a specialized set of environmental events. The focus is, or should be, on what the learner does and how well he or she does it.

Unfortunately, this focus is rarely stated. Most educators subordinate outcome to process. They debate at length about matters of process: should the math curriculum be changed, should more time be added to the school day, should teachers be paid more, should schools be segregated by sex, should every classroom have computers, should the superintendent be appointed or elected, etc. Missing from these learned discussions is any explicit statement of a relationship between such process and procedural

variables and measured change in the behavior of the students. This is surprising in light of the fact that considerable research has been conducted and published which documents exactly the required relationships. Failing to provide for sensitive measurement of outcomes virtually guarantees that student progress will be haphazard.

The fictional hospital previously described would not long survive because the outcomes it provides would be unacceptable and because other hospitals would provide more satisfactory outcomes. For over a century, medical science has made effective use of reasonably exact and direct measurement to establish the individual patient's problem, monitor the course of treatment, and determine when treatment is no longer needed. Such measurement provides a basis for documenting the outcomes associated with a particular hospital or method of treatment. It also anchors a system of remuneration which, although flawed in the eyes of many, serves a selective function in the continuing evolution of medical practice.

A similar measurement strategy must be adopted if education is ever to improve. Claude Bernard taught us in 1865¹ that in medicine, measurement must occur at the individual (not group) level, measurement must be specific to the objective of intervention, and measurement must be sufficiently frequent to provide timely notification of the need to change procedures. In short, measurement must be the basis of all other decisions and not, as is the case now in education, an afterthought which serves the needs of individuals far removed from the actual teaching process.

One of the objectives of nearly every first grade teacher is to teach reading. This means that a child will be able, after instruction, to see printed words on a page and say them aloud. It also means that the child will be able to answer questions based on the content of the material read. This behavior may be measured by speed and accuracy. These basic measures combined produce a measure of fluency.

Speed is measured directly. How many words per minute can the child say when presented with the printed page? Accuracy is measured by counting separately the number of words read correctly and the number of errors or omissions

that occur. Fluency is the rate or frequency of words read correctly with a minimum number of errors or omissions.

Behavior which is fluent is behavior which is functional; it fosters the survival and growth of the individual. A person reads or speaks a language fluently when he or she utters the words at a conversational pace with few or no errors. Standards of fluency are set by the demands of the environment and exist independently of the individual learners, just as standards for passing Board exams exist independently of the level of preparation of this year's crop of residents. Fluency standards can be determined objectively and unequivocally by measuring directly the performance of small groups of individuals recognized as competent in particular skills or areas of knowledge. For example, given a sheet of 150 simple addition problems (e.g., $7+4=$), most North American adult professionals can write between 80 and 110 correct answers per minute. This range objectively represents a functional level of competence in this math skill. It is possible to define objective fluency standards for virtually any other curriculum objective as well.

Research has shown that devoting no more than one or two minutes per day to this type of measurement is sufficient for most educational purposes.^{2,3} Displaying the results of such measurements on individual charts gives both teacher and learner a sensitive picture of progress. Research has also shown that each learner's chart will be different from the others. Instruction must therefore be individualized if each learner is to meet the established standards. This leads to very different instructional practices from the standard of teaching "the group," then using achievement tests after the fact to see which, if any, individuals learned anything. Conventional use of achievement tests is analogous to evaluating a community's medical services by an annual tally of funerals.

Graphic displays of individual learner improvement over time provide measures of both effectiveness (how many standards were met) and efficiency (how rapidly were they met). Combining these measures with cost figures provides the system of accountability⁴ which everyone says would be nice but nobody has found the political courage to implement.

Part of the problem lies in the tradi-

tional practices of accounting in education. Body counts are multiplied by units of time to create the denominator of cost benefit ratios. Rather than budgeting on the basis of cost per student day, the proper index would be cost per student fluency objective attained.

This would have the effect of allowing measured amounts of learning to drive educational decisions. Both success and efficiency would be rewarded, as they are in any enterprise that must meet stated objectives with finite resources. It would also have the effect of calling into account the contribution made by the many layers of administrative bureaucracy that now consume approximately two-thirds of the dollars appropriated for public schools.⁵ The attractiveness of private alternatives to public schooling (e.g., the voucher system being tried in Milwaukee), lies partly in the

sex, minimally be able to do in order to function competently in our society? A few obvious skills include: seeking, applying for, and securing a job; maintaining a bank account (including balancing a checkbook); becoming informed and voting in local, state and national elections; financing major purchases; and childrearing. There are many more. A number of organizations and agencies (e.g., the American Society for Training and Development) have developed lists of skills said to characterize a desired level of adult competence. Unfortunately, none have been specific enough to support the precise assessment procedures suggested here.

For each of the major skills identified, functional standards of speed and accuracy for the constituent behaviors must be established. Then, a hierarchy of

tute objectives which every child must meet. The task of the teacher is to arrange the child's environment so that this occurs. This is what we mean by teaching.⁶

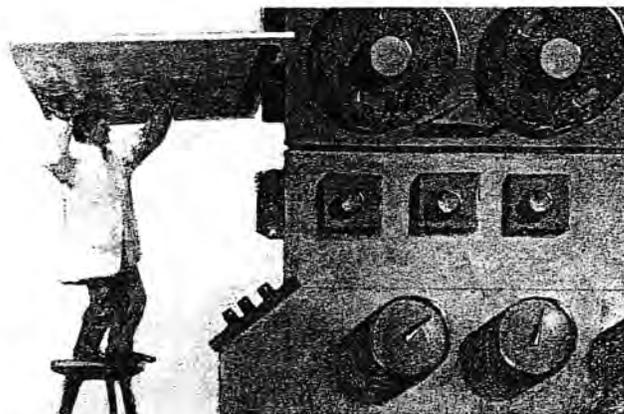
As each child progresses through the educational system, more and more tool skills are acquired and complex skills begin to emerge. Evaluation should be based solely on the number of skills or competencies mastered, with progress to more complex skills occurring only as the basic ones are achieved. This would replace age-related promotion with functional skill certification, permitting all concerned—teachers, parents and potential employers as well as the student—to know exactly what the individual has learned and can do.

After the Commission has completed and defined such a list of skills, its responsibility will be to update the list, based on

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extent to which these schools function with minimal overhead.

A PROVISIONAL TREATMENT PLAN

Progress toward a solution of our nation's educational problems will require a concerted national effort. It is reasonable to expect our elected officials at the national level to provide the leadership necessary to organize an effective assault on the problem. A bipartisan Commission should be established by Presidential appointment, subject to Senate confirmation, and can be chartered in perpetuity with its own procedures for appointment and succession. Otherwise, its function will be compromised by cyclical politics. The Commission should have two charges.

The first will be to write a job description for the U.S. citizen. What must an individual, regardless of race, region, or

supporting skills must be identified and taught, again to functional standards. For example, financing a home requires mathematical skills which extend beyond basic arithmetic to calculating percentages, compounding interest, and budget forecasting. Functional literacy may be similarly described; e.g., a person can read and follow the signs on a freeway while driving at or near the speed limit.

Each of the supporting skills will require a set of tool skills which are the job of the elementary schools to teach. Tool skills are those necessary for the more complex skill to be exhibited. For example, reading depends on the ability to see and say letters of the alphabet; computation requires writing digits, etc. Research has determined the speed and accuracy with which such tool skills must occur if they are to be functional parts of more complex skills. These values consti-

input from educators, business leaders, professional leaders, and representatives of higher education.

The second function of the Commission will be to establish a data base composed of skills attained. Every child, upon entering school, could receive an identity code or number (Social Security number?) and a central agency can begin a cumulative record for that individual in which attainment of each skill is documented as it occurs. (In the future, these records might be carried around by individuals on electronic "smart cards.")

Several means of documenting skills should be available. Teachers themselves can provide the certification, based on permanent products of the child's work. Additionally, a system of designated examiners can certify functional skills acquired elsewhere. These examiners may reside in most schools. Finally, formal

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achievement testing can occur to certify certain skills. Whenever possible, this should include a short, timed sample of performance for the purpose of documenting fluency. Attainment of certification will be added to the student's record and will be available to educators, parents, potential employers, and, of course, the student.

Implementation of the teaching functions should be done by local entities, as in the past. This will result in considerable variation in both approach and success. As is the case in many other fields, hard outcome data will empower the voters/taxpayers/consumers with a clear basis for choosing among alternatives. An independent organization like the Consumers Union could provide frequent feedback to parents concerning the performance of the school their child is attending as well as that of other schools the child could attend. The debates which are now raging concerning such proposals as voucher systems for private schooling, competency-based training for teachers, and decentralized administrative procedures will at last be informed by meaningful, objective data. Teaching will finally emerge as a true profession, identified and compensated by its outcomes.

SOME ILLUSTRATIONS

Do the procedures we have outlined work? Two examples illustrate successful application of this approach. In Great Falls, Montana, during the 1970's, the Precision Teaching Project demonstrated the cost-effectiveness of providing students with daily practice, fluency measurement, and charting of results. By adding just 20 to 30 minutes per day of this activity to an otherwise ordinary school program, Great Falls educators were able to boost the average achievement test scores (Iowa Test of Basic Skills) of an entire elementary school from 20 to 40 percentile points (depending on the skill area) over a period of three years.^{7,8} This is the equivalent of moving an entire school from below the national average in achievement to within the top 20 or 25 percent. The total cost was a few hundred dollars the first year for training teachers and about ten dollars per student per year thereafter for materials.

At the Morningside Academy in Seattle, Washington, students in programs using these methods routinely progress at

a rate of nearly two years of academic growth per month in the program.⁹ In the same program, homeless illiterate adult men have shown even greater gains. These results show how much improvement is possible in our existing schools by simply adding fluency aims and using precise, frequent measurement to assure their attainment.

Why are these procedures not readily adopted if they are so successful? The answer, quite simply, is that it is not in the economic interests of those so empowered to effect adoption. As Watkins¹⁰ described in her analysis of "contingencies that govern the educational establishment," many entrenched entities, from teacher unions to administrative councils to consortiums on teacher education, continue to prefer a system where body count rather than learning serves as the basis for funding.

Watkins bases her analysis, in part, on an examination of Project Follow Through, the most expensive educational "experiment" in U.S. history. Beginning in the 1970's the Federal government sponsored a programmatic assessment of several dozen early education programs by implementing them in school districts around the country and evaluating the results longitudinally. One of these programs, the Direct Instruction model from the University of Oregon, proved superior to all the others in improving children's basic skills, problem-solving abilities, and self-concepts. In contrast, some programs derived from theories cherished in Colleges of Education actually proved harmful by comparison to control schools where no federally funded intervention occurred. Faced with these unexpected findings, officials in the Department of Education averaged the outcomes across all programs, thus producing a "no change" result overall, and recommended that Congress direct more funding to the programs that were less effective.

Various elements of the educational establishment are known to resist effective innovations. This is particularly true of innovations that are not congruent with whatever theory happens to prevail among eminent professors in the nation's Colleges of Education. Add to these recalibrants the variety of political special interests who mistakenly believe that preservation of the status quo is necessary if their constituencies are to extract social

and economic gains relative to the larger society. These groups are notably indifferent to the consequences for all if the system as a whole continues to decline. Finally, factor in the complex system of regulation imposed by local, state, and federal agencies, all of whom have a role in the financial management of the schools, and you can appreciate why innovation and change are all but impossible.

These conditions have evolved precisely because there has been no universally understood and accepted measure of the accomplishments of the educational system. Adopting the simple measurement procedures proposed is a necessary first step in reversing the current trend. A highly desirable byproduct should be that frequent skill certification will solve many of the motivational problems that now plague America's schools. Every

we propose would not only work, but is desirable? Suppose that all the children up to 18 years of age in an entire state could advance, within a span of five years, to at least age-appropriate levels of academic achievement. Suppose further that the process by which this was accomplished also reversed a major economic misfortune which had befallen that state. That would probably persuade at least the literate majority. How could it be accomplished?

Missouri is home to the McDonnell-Douglas Aircraft Corporation which has been hard hit by the recent reductions in defense spending. McDonnell-Douglas also happens to be a leader in the design and delivery of instructional technology. They achieved this status out of competitive necessity; those who would build complex defense systems must not only design them so that they can be operated

would be federal—an application of the so-called peace dividend. It would therefore cost the state of Missouri nothing, enabling the State to retain its bureaucracy if it so chose.

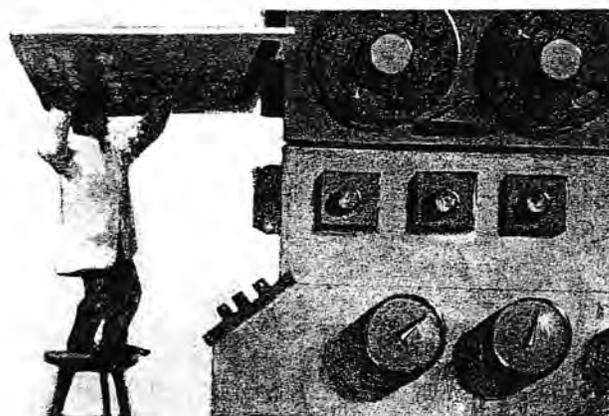
At the end of the five years, McDonnell-Douglas would be obligated to return to the Treasury a pro-rata share of the costs for each student who fails to achieve at a level commensurate with his or her age, calculated on the basis of unmet objectives. For every objective achieved beyond the age-appropriate minimum, however, McDonnell-Douglas would receive a bonus. Evaluation would be by independent examiners, as outlined above. The State of Missouri would have the option of renegotiating with McDonnell-Douglas or returning to their previous practices.

Will this experiment be done? Prob-

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child will experience success, more or less in direct proportion to his or her ability and effort, because each child's educational program will be managed on the basis of frequent measures of performance. Gone will be the experience of spending days or weeks making no visible progress and hence receiving no recognition and encouragement. Instead, attending school should become an experience of lasting value and will make learning a reinforcing activity throughout the individual's life. At least it will ensure that school becomes a place where effort and achievement are recognized and rewarded. That alone will do much to improve the current situation.

A RADICAL EXPERIMENT

What would it take to convince the American public that the type of wholesale renovation of our educational system that

by humans, they must then develop and validate the training procedures through which humans are taught to use the systems. In the course of developing the necessary expertise, corporations like McDonnell-Douglas have become very proficient at designing and delivering non-military training as well.

We propose that the State of Missouri contract with McDonnell-Douglas to provide the educational services for all the children of Missouri in grades K through 12 for five years. McDonnell-Douglas would receive a: compensation exactly the same number of dollars per pupil per year that are now spent. It could lease the physical plant from the local school districts if it so chose. It could offer positions to those individuals in the existing educational establishment it considered worthy, but it would be under no obligation to do so. Funding for this experiment

ably not, unless Senator Danforth and Representative Gephardt can agree to join forces and clear the political obstacles which would surely doom such an idea from the outset. Should it be done? It already has been, but on a much smaller scale, in many communities throughout the nation.

Major employers, such as Boeing, have found it necessary to immerse themselves fully in the process of public education in order to guarantee an adequate level of public education in order to guarantee an adequate level of competence on the part of their new employees. These employers are having to pay twice for competent workers, first in property taxes and a second time in direct training costs. These companies are proving that we have the know-how to affect the educational outcomes required for functional participation in our society. The rest

of us must summon the political will necessary to demand such outcomes for society as a whole. As Chester Finn puts it, "We must take charge!" Our children, and our way of life, deserve no less. ■

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