Why the Schools Can't Improve: The Upper Limit Hypothesis

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Introduction

The first purpose of this paper is to question whether there is a significant discrepancy between the current levels of productivity and quality of American schools and the levels required to serve the society well. The second purpose questions whether the current approach, or the approaches of blue ribbon commissions are likely to produce significant improvements. A third purpose sets forth the hypothesis that the current school operations model cannot be improved by the recommendations offered by the National Commission. The fourth purpose is to suggest that some form of technological intervention must be made before any substantial increases are made in productivity.

Are Quality and Productivity Problems?

Numerous researchers have recently addressed this persistent question from a variety of perspectives: including Murname (1975), Heyns (1978), National Commission on Excellence in Education (1983), Coleman, Hoffer, and Kilgore (1982), Aker, Spaulding, Adams, and White, (1984), Walberg (1984), Kozol (1985), Bickel (1986), Pallos (1986), Bureau of the Census (1987), and Walberg and Fowler (1987). Common among these researchers and reports is the conclusion that school performance and quality are severely inadequate to meet the needs of modern society. Further, Boulding (1972), established that not only are the results disappointing, but that the real costs of schooling doubled between 1930 and 1970.

Parent organizations, state education agencies, the United States Department of Education, and blue ribbon national commissions, have all agonized about the problem, and some have offered concrete proposals for improvement (e.g., National Commission on Excellence in Education, 1983). Virtually all of these proposals have centered on trying to repair, stimulate, and improve the existing educational establishment. They have implicitly accepted the current operations model as adequate and have urged changes intended to improve it. A major contention in this paper is that the existing operations model is seriously flawed and cannot simply be patched up for modern use. A second contention is that even if these proposed changes could be successfully made, they could produce, at best, a limited improvement.

Commissions, state education agencies, and teachers organizations, all seem to urge additional funding, but the empirical evidence has not demonstrated any solid relationship between funding and school performance (Boulding, 1972; Murname, 1975; Walberg & Fowler, 1987).

Is there a documented problem in quality and productivity? In this paper, "quality" refers to both quality control and quality assurance concepts as elaborated by Lessinger (1976). The quality control question centers on how closely what happened resembled what was planned, (e.g., Do actual mean achievement scores match expected scores?). The quality assurance issue addresses the fitness for the intended use, (How well prepared is the graduate to meet employability requirements or succeed in additional schooling?) (Juran, 1974). Productivity refers to the relative achievements of the students compared to the relative expenditures.

Walberg (1984) compared American students with those in other developed countries and found that we are clearly second-best compared to any other industrialized country on commonly used measures of language, mathematics, and science. More recently Walberg and Fowler (1987) concluded:

> A substantial literature shows no consistent association between spending on education—including total per-student expenditures as well as specific spending on such things as class-size reductions, physical facilities, teacher salaries, and the like—and how much students learn. (p. 6)

Aker, Spaulding, Adams, and White (1984) used an absolute output measure, functional literacy, to infer instructional outcomes. They estimated the number of functional illiterates to be about 12.5 million, with the number not able to function at levels of conceptual development attainable by some students in good high schools to be more than 50 million (see also Kozol, 1985). According to the United States Center for Education Statistics, the average score on the international eighth grade math test was 52; the mean for American students was 46. The functioning and literate remainder of the society is carrying this economic burden.

According to a recent story in the *New York Times* (1987), a hiring program established by four New York Banks to employ 250 qualified graduates, yielded only 100 graduates who could pass the entrance test that was roughly equivalent to an eighth-grade mathematics test. The United States Army must spend millions of dollars each year to prepare high school graduates in functional basic skills prerequisite to job training programs (Branson & Farr, 1985).

If the banks cannot find qualified applicants in times of high youth unemployment, and if the taxpayer must pay twice for the same schooling as it does when Army recruits must be given remedial instruction in basic academic skills, we will certainly continue to find ourselves in situations of low industrial productivity and a worsening trade deficit. Thus, Walberg (1984) argued coherently that our

schools have not kept up with even the smokestack industries in terms of increased productivity when measured over comparable time periods.

While we must make our individual, personal evaluation of school performance, there is an emerging consensus that the current levels of performance and efficiency are unacceptable, and that direct action is required soon. But what kind of direct action? There appear to be two distinct views:

- Those who believe that significant improvements can be made in the present operating concepts and models (National Commission on Excellence in Education, 1983; Finn & Tomlinson, 1987; Florida Department of Education, 1987), and;
- Those who accept the argument, to be urged here, that *fundamental* redesign must occur before any important improvements can be made at all (Branson & Grow, 1987; Reigeluth, 1987, in press).

Common among these researchers and reports is the conclusion that school performance and quality are severely inadequate to meet the needs of modern society.

Responsibility

In the operation of any organization in which professionals come into contact with clients, the professionals must assume the responsibility for the success or failure of treating the client. Individual diagnosis, therapy, and programs of implementation must be carried out diligently to make a difference in the lives of the people served. To the schools, this would mean taking the best available practices and the best available research data and putting them together to optimize a treatment system that would produce results. Successes and failures would have to be identified and attributed.

Although I have tried to set the stage for urging improvements, I want to declare explicitly that I do not believe that there is any culpability in the current state of affairs. If there is blame, we are all to share it. We do have a significant problem and we must get on to fix it, but to fault any group would be entirely wrong.

The Life-cycle of a Maturing System

Life cycles of maturing technologies and systems can be represented by a sigmoid curve as presented in Figure 1. The introduction of any process is characterized by an extremely slow start with a limited relative productivity. This slow beginning gives way to a rapidly changing rate until increases in productivity begin to taper off and the system approaches the upper limit (asymptote) for the process or technology. For any system or enterprise, there is an upper limit of achievement at 100%, which is never reached. As indicated in the curve, the view presented here is that the traditional education model has attained about 97% of its possible performance.

By going through this process of estimating the total potential improvement in outcome or productivity, a process which I call "back-end analysis," it is possible to estimate the contribution of any proposed fix or change in the system. It is the same general process that we go through when we decide to repair or replace any major piece of equipment or system. Costs are traded off against value or productivity, thus providing the rational basis for a decision.

Technology Perspective

Compare the existing concept of school structure and operations to the design and operation of aircraft. The history of aircraft design roughly parallels the history of educational research. About the time of World War II, 1940, aircraft design for single and multi-engine aircraft had been effectively optimized. That is, engine manufacturers and airframe manufacturers had produced about as much efficiency as they could produce under the existing piston engine technology. For each aircraft mission, the designs were approaching the practical upper limit of capability.

Aircraft designers must take into account three major factors when producing an aircraft for any defined mission. These factors are:

- Speed,
- Payload, and,
- Range.

For any mission, these three variables must be traded off—optimized—to achieve the performance requirements. It is not possible to maximize all three variables simultaneously. If you want more speed, you must give up range or payload. Mission requirements for aircraft design are the equivalents of system requirements for what could become an educational "system." While education may now be a system in the sociological sense, it is not, in my view, a system in the cybernetic sense. The mission and system requirements for education will be discussed in a later section of this paper.

I will argue here that all major possible improvements to schools, under the current management model, had been implemented by 1950 or 1960 at the latest. The results under this model have reached their practical upper limit; that is, performing in the vicinity of 97% to 98% as well as they can ever function *according to the current design philosophy*. Trying to make improvements to operations under the current management structure can yield, at best, only a 2% to 3% improvement and to achieve even that trivial gain would require immense investment. It is well known in quality programs that the last 2% to 3% improvement to a "zero-defect" goal can cost half again as much as the first 97% (Lundvall & Juran, 1974).

Marketing Perspective

Such curves can also describe the market introduction-penetration-saturation process for products and serv-

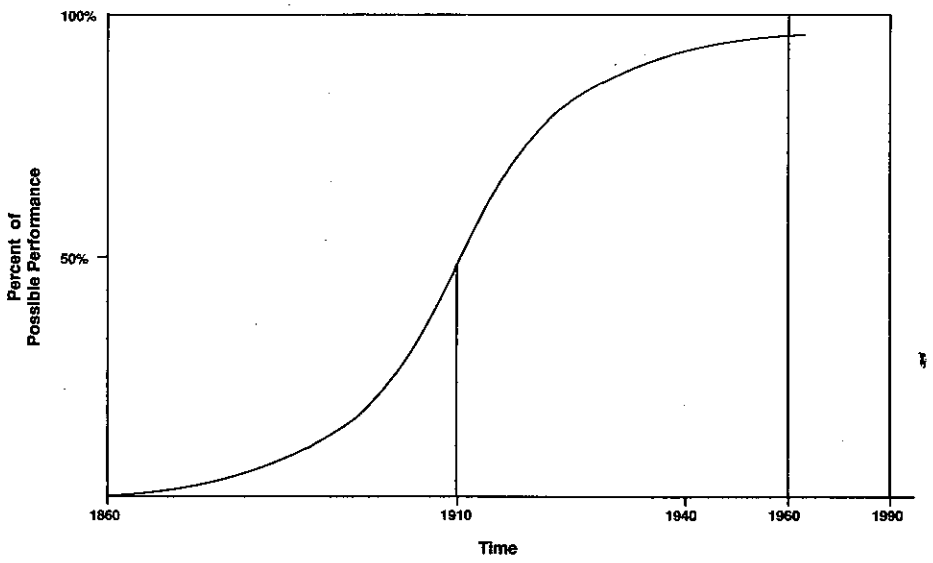

Figure 1. Hypothetical upper limit of productivity of the traditional school operations model as a function of time. This function was adapted from the concepts of maturing technologies and markets.

ices as well. The curve describes the early process or penetration in terms of the absolute percentage of possible achievement. From a marketing perspective, if 50% of the American people now see a dentist regularly, as indicated on the curve, there is a theoretical maximum possibility that dentists could see a 100% improvement in their market. In this particular case, the 50% they now see probably represent 90% of the currently available purchasing power. While they could see 100% more people than they now do, most of those people not now being seen cannot afford to pay, thus, there is not a high probability of a 100% improvement.

Negative Research Results

It is one of my major contentions that many of the negative findings with regard to discovering what many people believe are intuitively obvious relationships among educational practices (teacher pay; per pupil expenditures; teacher training; class size) are due to the near asymptotic condition of existing practices. When all schools have approached the practical upper limit of performance, there is so little room for improvement in the traditional variables of interest, that significant differences reported in the literature are more parsimoniously explained by sampling error. That is, the true difference in population means is zero; those differences that are found are due to chance (see Bickel, 1986). I will further contend that this account is far more parsimonious than the endless explanations of the practitioners (see Boulding, 1972) who believe that the true mean difference is not equal to zero.

Yes, some schools are better than others, some cost more, some have better students, some have better teachers, some have better principals, but these distributions are normal and *independent*. Relationships among them are better explained by sampling error than by methodological faults in the research. Traditional school attributes and operations variables are random processes, not principled ones. Making one school better can often make other schools worse. A given school gets better, but the average for all schools does not.

Suppose, though, that this argument is completely wrong; that true differences do exist. The reported effect sizes are still trivial. That conclusion is also best interpreted from the perspective that there is no important room for improvement (see Glass, 1987).

Conventional Fixes

With the noblest of motives and the best interests of the nation at heart, the National Commission on Excellence in Education (1983), made numerous recommendations that are not likely to have any real and immediate impact. We are a nation at risk. In this paper, I will argue that their proposed solutions to school problems cannot be effected and implemented, and, even if implemented would not result in significant improvements. Improvements that could have an impact, such as those described by Walberg (1984), cannot be widely implemented, and even if implemented could not now be sustained and managed (see Reigeluth, 1987; Parish, Underwood, & Eubanks, 1986-87).

I will further contend that blame-placing and single variable fixes, such as teacher training, pay incentives, longer school days, and longer school years, cannot be efficient means of improvement. The problem is principally one of system design, not of faulty operation. It is critical to make

that distinction. No group can be singled out for blame: not teachers, not principals, not school boards, not parents (see Finn & Tomlinson, 1987; Glass, 1987).

To blame these groups for functioning in the system as their roles have demanded, would be similar to blaming the pre-antibiotic medical establishment for failing to cure infections. Better physician training, better nursing training, and improved hospital management would have helped little without the technological breakthrough of penicillin.

There is also a continuing and well-lobbied view that schools do not have adequate financing, in spite of consistent findings that school quality is not related to school cost (Boulding, 1972; Murname, 1975; Walberg & Fowler, 1987). Those results can also be readily explained from the near-asymptotic performance perspective. Since the greatest percentage of additional funds provided to the schools are consumed by teacher salary increases, no affordable level of funding would ever be thought of as adequate. Thus, the problem is one of resource use, not of resource amount.

Systems can fail because they are obsolete; because they are overloaded; because they have fundamental design flaws; and, because they have inadequate management.

Design Versus Operations Problems

The principal argument here is that fundamental flaws in management and operations permeate the contemporary education establishment. The education sector was never *designed* to meet today's needs; it matured by reaction to various political and social influences over an extended time period. That maturity is represented by the sigmoid curve in Figure 1.

Systems can fail because they are obsolete (which I believe is the case in education); because they are overloaded; because they have fundamental design flaws; and, because they have inadequate management. Some examples of system failures with different causes might clarify this point.

Overload. In the mid-1960s, there was a complete electric power blackout in the Northeast, resulting from a surge in demand and a design problem in the distribution system. It was not possible to identify a group or person responsible, only a failed part.

Undercapacity. Current analyses of the United States air-traffic control system indicate that it cannot meet the demands placed on it, causing an increase in flight delays, near misses, and other unfavorable statistics. The problem cannot be blamed on the air-traffic controllers, or President Reagan for firing members of the striking union, or the airlines. The system cannot meet public demand. Reducing the number of flights is a palliative, not a cure.

Obsolescence. Galley slaves were once used to power ships. Could the navy have really improved the performance of the armada if they had: selected stronger slaves; trained them better; given them more money, fewer lashes, or better rations; waxed the hull; redesigned the oars; provided swivel seats; or, told them how important it was to the Queen for them to work harder?

NASA's Management System Failure

In early 1986, on the morning of President Reagan's State of the Union message, the space shuttle, Challenger, was launched from Cape Canaveral during a rare Florida cold snap. Shortly after liftoff, one of the main booster rockets exploded and caused the shuttle to fall into the Atlantic. Instantly, a national demand was issued to find the culprits and deal harshly with them. Ultimately, it was found that the proximate cause of the accident was a defective o-ring.

If you believe that disaster was an accident caused by a defective o-ring, then you will probably also believe that single variable improvement schemes will improve public education. The accident was caused by a major *system flaw*. The shuttle was launched on a day that was clearly too cold for the vehicle to endure. The NASA launch director was warned by the manufacturer that the weather was out of tolerance. The contractor was threatened with reprisals if he persisted in recommending a launch delay.

If there is a major system flaw, any new launch could go with some other system out of tolerance—temperature, cloud cover, lightning, wind, and many others. Fixing the o-ring, though probably necessary, is not sufficient to fix the system. The o-ring was merely a scapegoat. NASA is, however, still throwing money at the o-ring, and it is attempting to change its system. Will it succeed in solving both problems? A large government system is a close analogy to the kinds of problems being discussed here.

In each of these examples of system inadequacy, the owners and operators were not at fault, the system design and the available technologies were not adequate to meet the increased needs. While no systems are perfect, examples of effective systems, presented in the sections that follow, should help to define the scope of the problem addressed here.

Meeting Changing Requirements

In the 1950s, a major bank projected the number of checks that would be written by customers during the next ten years. Then, by estimating the number of checks each clerk could process in a day, they came up with a staggering conclusion: There would not be enough space in the bank for the number of people required to process the checks they forecasted to be written. What to do? Redesign the check processing system by including optical character recognition and automatic data processing. Without the availabil-

ity of a new technological development, the banking system, as we knew it, would have collapsed from the paperwork burden.

In my hometown, Shawnee, OK, making a telephone call involved lifting the handset, waiting for the operator to say, "Number, please," then giving her my friend Tommy's number, and hearing her ring the number or say, "The line is busy." When my neighbor, Louise, was the operator, she would even say, "There is no one at home, I just tried that number." There was no need to complete the call.

Recently, I pressed one button on my automatic dialer and was speaking to a colleague in Paris in less time than it took Louise to ring Tommy. In the last twelve months, my telephone has not been out of service for a single day. The voice quality is good, it transmits data, it is an excellent value for the price, and, by adding features like international direct dialing, the system has continued to meet my increasing needs by adding features. Though mature, the system is not obsolete. Wires were replaced by microwaves, microwaves by satellites, and both have been augmented by fiber optics. All permit me to use the same black dial telephone that I have had since 1960.

The essential elements of success in both cases has been to focus on system output requirements, to keep what was good and what worked in the old systems (handwritten checks; black rotary telephones), to replace that which no longer met system output requirements (local service operators), and to increase the capability of the systems through ingenious applications of technology and effective management.

How could major change be managed in these two well entrenched bureaucratic systems, to meet changing needs? What can be learned from organizational changes that have worked, that could be tried in the educational establishment? Is there an available technology that could improve education? Since we have convincing research evidence that there is (Walberg, 1984), why have similar technologically-based changes not taken place in education?

Recommendations of the National Commission on Excellence in Education

To illustrate the difficulties of making improvements within the confines of the current establishment, let us examine selected recommendations from *A Nation at Risk* (1986), in light of what has been learned in educational research and development during the last 75 years.

Recommendation A

"Minimum requirements of 4 years of English, 3 years of mathematics, 3 years of science, 3 years of social studies, one-half year of computer science," (p. 24 ff).

Three problems are: first, numerous studies of mastery learning have taught us clearly that when students are managed to achieve mastery of the objectives, different amounts of time are required for different students. Stating recommendations in terms of years of instruction rather than intellectual competencies, is an erroneous practice no matter how widespread.

Second, all emphasis is on *teaching* rather than providing learning. On saying, "Number please," rather than arranging fast, efficient connections.

Third, the report recommended that more hours be spent in school each day for more months, rather than providing for increasing time-on-task and providing effective feedback.

Recommendation B

Raise standards and expectations for improved academic performance, (p. 27 ff).

A commendable goal. One just *cannot* urge lower standards.

One problem is: It is the same as urging better times for the track team with no mention of how to reach that goal. Just as in manufacturing, quality cannot be inspected into a product, it must be built there (Juran, Gryna, & Bingham, 1974). Higher standards cannot be tested into an educational system, competencies must be systematically built into the students.

Recommendation C

Have higher standards for teachers and raise teacher salaries, (p. 30 ff).

Two problems are: first, having higher standards (higher grades in college) for teachers does not address the issues of competencies they ought to have and know how to teach well. Following the medical example, in the absence of penicillin, flunking out more physicians would have had no impact on the infection death rate.

Second, paying higher salaries to teachers has only political appeal. There are no known instances in which paying incumbent teachers more money resulted in higher quality or productivity. Further, the same class can be taught equally effectively and much less expensively, by teachers with three years of experience instead of twenty years of experience. There is no evidence that paying higher salaries to those teachers for another 20 years will result in increased effectiveness or productivity, although it would certainly result in increased costs (see Murname, 1975). A salary structure that provides increased pay for more time in service and more hours of instruction at the university may not be the best option for the taxpayers (see Boulding, 1972; Walberg & Fowler, 1987).

Florida's recent experience indicates that only about 7.75% of the workforce of some 100,000 teachers are new hires

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in any year. If one assumes that these new hires are distributed approximately randomly across the grades and the schools, it would amount to about 4 new teachers per school per year. At those odds, each new hire would have to be a miracle worker to have any real impact on the establishment. Unfortunately, unless the new hire is the CEO (see Iacocca, 1984), the literature tells us clearly that the organization is far more likely to shape up the new hire, than the new hire is to shape up the organization (Cornbleth, 1986).

Do More, More

Another government publication, *What Works*, (United States Department of Education, 1986; see also Glass, 1987; Finn & Tomlinson, 1987), urges schools to adopt practices known to work in other schools. Increasing quantity and quality of homework are urged as a means to "... teach students to be independent learners." This benefit is presumed to be a byproduct of their learning the subject matter. Homework is treated as an end rather than a means. It is reasonable to raise the design question, "What is the instructional, management, or discipline problem for which homework is the optimum solution?" Do students from all socioeconomic groups have an equal chance of profiting from homework? Should they?

The Miracle Worker

In another section, schools are urged to get the "right" principal because good principals can turn bad schools into good ones. A management structure that leaves the decision about whether a bad school ought to be turned into a good one, to the whim or inability of an incumbent principal, is going to fail no matter what it attempts to do. The very fact that a bad school is known to exist in a system ought to scream loudly enough to cause direct management action to insure that the school is as good as it can be.

Regardless of management's indifference or ineffectiveness in making schools as good as they can be, blaming a principal for bad school performance is much like blaming a 1940 hospital administrator for deaths caused by infection. The existence of bad schools is clear evidence of system failure, not of bad principals.

Probably the most dangerous aspect of the report, suggesting that the solution lies in getting the right principal, is the fact that we will be looking for miracles in the person, not in the system. There just aren't that many miracle workers available. The true hazard stems from the publicity about an occasional miracle—someone actually does come in and save a school from disaster—then the superstition builds that miracle results can be similarly obtained in other schools. When dramatic results are not achieved, the principal gets blamed, or changed, nothing is done to improve the system, and as in any other superstition, the endless cycle of false hope is sustained. A specific example of how a principal can work negative miracles will be presented later.

No matter how well motivated the reports may have been and no matter how prestigious the members of the Department or Commission, I believe that these reports and others that preceded them have suggested that we do more, and longer, of what is not working now, pay more for it, make it more difficult for new applicants to get hired, and screen more students out of the universities. These reports have not, in my view, provided us any basis to hope for success in the 1990's (but see Smith, 1986).

Historical Perspective

In the late 1960's, the United States Office of Education undertook an extensive study of the operations and performance of the public schools in the United States (see Morgan & Bushnell, 1967; Morgan, 1969). When they studied, observed, and interviewed groups representing teachers, administrators, principals, school board members, and the general public, they concluded that the schools were as they were and were unlikely to change. Their most significant observation was that *there were no villains in the piece;* the blame for the massive problem could not be laid at the feet of teachers, or unions, or parents, or elected school board members, or principals, or any other power group. The performance problems in the schools were caused by inherent structural and operations faults and the probability of success of any single "fix" to the existing model was low.

Morgan and his associates recognized that system faults must be addressed with system solutions. Simplistic, single-variable fixes, advocated by different power groups, were found to be completely inadequate. Subsequently, they organized a consortium of school districts across the country to participate in the development of an organic curriculum (Morgan & Bushnell, 1967; Morgan, 1969). They sought to develop a systemic curriculum that would relate broad new ideas, new concepts, new thoughts, and vastly improved methodologies to get the schools closer in touch with the society they serve. In spite of the hard work, money, time, effort, and good intentions, the consortium could not make and sustain any important changes.

Why didn't the new approach survive and flourish? There were three reasons. First, there was not an adequate infrastructure to provide people with the knowledge and skill they needed to operate in the new environment. Second, all of the work was being carried out in the face of tradition; compromises had to be made that reduced the impact of the changes. Third, over time, goal conflicts developed or were found within the cooperating systems and within other pro-

grams in the Office of Education (Branson, 1979). As a consequence, the money programmed for the change was not provided over a sufficient period of time to institutionalize the new model.

After hearing about Morgan's experience, and clearly understanding the basis for his conclusions, I wanted to try my own hand at making school fixes. Because I had always worked on Instructional Systems Design programs from the top down (e.g. Oakland Community College; Parks Job Corps Center; The United States Naval Academy) and was thoroughly familiar with the pockets of resistance that had to be overcome in those programs, I naively assumed that if ideas and proposals for change originated at the grass roots level, they would be accepted, implemented, and then institutionalized. Based on my own experience and the change agent literature, I believed that whatever teachers liked, teachers would do, and that they would do only what they liked.

Flat management models do not permit the development of high-performance systems regardless of whether one is working in schools, factories, government agencies, or athletic teams.

In early 1970, I was trying to find a school in which to begin a cooperatively developed instruction and management model, keep that model in place for a period of time, manage the program well, and make planned adjustments to the design and operation as required by using the accumulated performance data. I looked at candidate schools in the Bureau of Indian Affairs, continuation schools, proprietary schools, and others, including military training programs, finally selecting a school operated by the United States Dependent Schools—European Area (USDESEA).

The USDESEA Project

In 1970, the Center for Educational Technology at The Florida State University signed a contract with USDESEA to provide design and development service to the Karlsruhe American Elementary School in Karlsruhe, West Germany. Overseas Department of Defense schools are identical to typical schools within the country, except they have a higher turnover of students. As military personnel are transferred from one post to another, their children get hopelessly out of step with the other students who are not moved. It was the turnover problem that provided a focus for the systematic curriculum design.

During a period of three years, we worked with teachers and administrators to define an educational mission consistent with Army needs, elaborated program objectives, and developed a plan of action with milestones. In-service training was provided for teachers and administrators to establish the basis of cooperation in designing a new curriculum, developing it, and implementing it.

This finally approved curriculum was a hybrid of off-the-shelf materials developed by the Regional Educational Laboratory for the Carolinas and Virginia (RELCV), materials developed by teachers specifically for the school, and other commercial off-the-shelf courseware, traditional and nontraditional.

The RELCV-developed program was the *Individualized Mathematics System*, a fully integrated, continuous progress K-12 mathematics curriculum, that had been carefully field tested in schools throughout the Southeast. In addition to mathematics, the language arts, science, and social studies parts of the curriculum were also developed on a vertically integrated basis.

From all professional viewpoints, it was technically sound, it worked, and it was a perfectly acceptable curriculum to the Karlsruhe faculty. The project staff and teachers believed that we had made a major breakthrough in technology transfer; we had installed a research-based and fully tested curriculum in a school that had not been one of the tryout schools.

The first tryout of the new curriculum and materials was during the school year 1972-1973. Based on that tryout, certain revisions were made to accommodate problems that had developed. There was still, however, solid support from the teachers and principal. During the summer following, the final versions of the materials were reproduced and plans were made to implement the program the following year on a school-wide basis.

Comes the Villain

A new teacher, who was transferred to the school in the fall of the 1973-74 school year, decided not to participate in the integrated curriculum. That fourth grade teacher told the principal to remove her class from the program; she intended to use the books she had used the previous year. The project staff and other teachers protested this arbitrary decision to the principal and to the various central office coordinators, but to no avail.

The principal, under some strange interpretation of the concept of academic freedom, was unwilling to tell the teacher that this was a well developed program for all students in the school and insist that she participate. The principal, not one of the miracle workers described in *What Works*, and who had been appointed during the second year of the project, permitted that single teacher to abort a program that we had spent three years developing. He really didn't want more work for himself or the administrative heat that would have been generated by insisting that the teacher participate.

This decision illustrates precisely why the management structure is faulty. In fairness to the principal, he did not participate in the plans that would affect his professional life. The school culture of the day did not require that he accept what had been

done by his predecessor. He could regard what went before his arrival as invalid, unimportant, trivial, or excellent, according to his own whim. The fact that the central office had invested many thousands of dollars and thousands of person-hours to develop the curriculum was of no consequence in his decision (Branson, 1979).

While we tried all avenues known to us, we could do nothing to set the project right. We finally learned that so long as individual teachers can make whimsical decisions to abort major programs, it will be impossible to make improvements in education. Teachers are unable to make system fixes.

While we recognized that this particular problem would not have happened in many well-managed schools, particularly when we had the support of the principal and the entire staff, it does reflect the critical importance of the principal to any change effort. More importantly, it highlights that fundamental flaw in school management. While thousands of dollars were spent in developing a new approach, the management structure was not sufficient to get it implemented and sustained. The same kinds of failures have occurred repeatedly in numerous single school and district programs throughout the country (see Parish, Underwood, & Eubanks, 1986-87).

The Korean Model

Morgan saw the potential to cause educational change from another perspective. He reasoned that if one could really get central government support, and the support of significant academics and ministry staff, change models could be implemented. Instead of starting at the grassroots where I was working, he started with a major needs analysis and master plan in Korea (Morgan & Chadwick, 1971). In Korea, the federal government is paramount. With money from the United States Agency for International Development, and extensive support from the Korean government, he initiated and brought to fruition a fundamental improvement in Korean education (Morgan, 1979).

Why did Morgan's ES '70 program (1969) fail and his Korean program succeed? Both had funding from the United States Government, both were managed by the same person. Both had the involvement and support of significant members of the educational community. Both were managed from the perspective of the central government.

The view presented here is that the traditional education model has attained 97% of its possible performance.

First, there was a clearly documented problem; the Korean schools could not meet the needs of the society. But that conclusion has been repeatedly reached in the United States. Second, there was a strong central government commitment to make the necessary changes. That is not the case in the United States (see Finn & Tomlinson, 1987). Third, the Koreans created a technological infrastructure, in the form of the Korean Educational Development Institute (Morgan, 1979), to provide design, training, research, and evaluation services to the country during the time of transition. That kind of institute does not exist in the United States. Finally, the combination of the overall commitments and the developed infrastructure kept the program in place long enough for it to be adopted, to be successful, and to be institutionalized on a national basis. That last point is critical. In the United States, the central government funds projects annually, and rarely supports projects for longer than three years. Three years is not long enough to make a fundamental change in any large system.

Management Structure

The organizational model of the typical American school is extremely flat. That is, one principal is assigned to supervise as many as thirty or more teachers and other staff. Adequate supervision of that many teachers by one principal is logically and empirically impossible. Flat management models do not permit the development of high-performance systems regardless of whether one is working in schools, factories, government agencies, or athletic teams. The span of supervisory control has been documented since at least the time of the Roman Empire, and probably before the Pharaohs, to be seven plus or minus two.

In Rome, where teachers were first put on the public payroll, the school model was based on one administrator-teacher and several teachers, but not thirty. Schools operated with selected students and were small enough to be easily managed by one person. That model met the needs of the Romans of the day, though it certainly does not meet their current needs any more than it does ours. Recent research suggests that there is a negative relationship between school district size and achievement (Walberg & Fowler, 1987). However, if one accepts the practical upper limit hypothesis advanced earlier, this modest relationship would likely be attributed to sampling error.

When schools in the United States were started, they, too, were small and could be comfortably managed by one principal teacher. Then, the colossal error occurred. It was assumed that one principal could manage 9 teachers, then 15 then 30, but no true management analysis was made. In those days, there was no longitudinal evaluation of the schools. They existed as they had mutated and evolved from the Roman model. They were never planned according to a set of defined requirements; they were rationalized according to what they were. The current management and operation structure of the schools has evolved from an original model that served small primitive schools adequately. The same approach is now used in an attempt to manage large schools and districts. Generalizing management structures that are perfectly suitable for small schools, with simple requirements, to

much larger schools, trying to serve a complex society, leads inevitably to chaos. It has.

There have been no sustained managed changes in the typical school model in the last one-hundred and fifty years even though there have been enormous advances in educational research and development that could provide the basis for changes in instruction, organization, and management. There is a fundamental difference between designing a management structure to achieve a mission and a current school administration which results from evolution, reacting to fashions, trends, and political whims. The public school administrative structure was never designed to serve mission oriented requirements.

To their well deserved credit, hard working and dedicated administrators and teachers had optimized existing management and operations models by 1940. Certainly by 1960, traditionally organized schools were operating as well as they would ever be (see Figure 1). While minor improvements may be made by fine tuning the traditional model and procedures (e.g., by implementing the recommendations in *A Nation at Risk*), the chances of any significant improvements are effectively nil; the operations asymptote has long ago been closely approached. It is still my conclusion that more than 95% of all possible improvements in the system under its current management and operations configurations have already been made. Unfortunately, national commissions are willing to accept the obsolete; they are willing to commit resources to obtain that last 4 or 5%.

System Requirements

What are the major flight variables (e.g., speed, payload, range) in education? For the purpose of the argument here, an abridged list might include:

- To provide for effective and efficient learning throughout the range of student talent served by the district.
- To provide for socialization, growth, and development.
- To provide a safe, nurturing environment that promotes physical development and recreation.

Instruction

These requirements must be traded-off against resources and time to achieve the mission. Within each variable, there are numerous well established methodologies that define the state-of-the-art. For example, what can be done to make learning more effective and efficient? Walberg (1984) has documented the utility of reinforcement, mastery-learning, reading-training, cues and feedback, among many others. Others have established time-on-task as critical. Keep in mind that Walberg's findings refer to traditional classroom organization and that the interventions that he described were not designed into an operating system, they came from reports of research projects in the literature.

Socialization

What can be done to enhance socialization? Again, Walberg (1984) urges some important practices: Cooperative learning, and class morale. Delquadri, Greenwood, Whorton, Carta, and Hall (1986), among many others, have urged classwide peer tutoring. There are numerous approaches to improve socialization, such as manipulating teacher expectations (see Thorndike, 1968).

Custody

How can the custodial function be facilitated and improved? Madsden, Becker, & Thomas (1972), present a model for student management that has a very impressive history in improving discipline and performance. There are many other research-based procedures available.

These three requirements can be manipulated and traded-off to carry out the mission successfully. Success will not just occur spontaneously to meet the mission or system requirements. The entire process must be managed into place and competently operated to achieve the planned results. Operations refers to the day-by-day diligent attention that is devoted to the progress of each student, the early identification of any discrepancy between expected performance and actual performance, and the action taken to correct these discrepancies. Yes, adequate data management systems do exist that are fully capable of keeping up with thousands of students.

Back to the Drawing Board

How did aircraft designers improve the performance of piston-engine aircraft beyond their theoretical upper limit? They didn't. A totally new power concept was introduced in the 1940's, the jet engine; a fundamental advancement in technology. When the jet engine was brought into the aircraft industry all three major flight variables—speed, payload, and range—could then be completely reset and reconsidered. Now it is possible to design aircraft that will fly faster, farther, and carry greater payloads than were possible with piston engines, even though the same three mission requirements must still be traded off. Most important, the designers were aware of the technological advance and knew what to do with it when it was made available. They were seeking ways to make improved technological changes.

The existence of bad schools is clear evidence of system failure, not of bad principals.

Is there a jet engine of education? Perhaps it has not been invented yet, perhaps it has arrived. Regardless of the form it takes, I believe that it will be a large advancement in information processing technology. Some argue that it is CD-ROM, others that it is interactive videodisc. The form of the hardware is not important. What it must do is to bring vast amounts of information into contact with the appropriate sensory modality and man-

age the input and output of that information to produce effective learning and affective experiences (see Ofiesh, 1987a, 1987b).

We must find a way to bring the available research and technology in the behavioral, management, and communications sciences to bear on the school problem. Unless we can find a means of achieving significant change in public education—the jet engine of instruction and the improved airframe structure of management—it will not be possible to make any real improvements in the ability of the educational establishment to meet the ever-changing mission requirements, and education will not be able to support national priorities.

What Will Not Work

Continued performance of old school operations rituals will be no more effective than practicing medicine exactly like it was practiced in 1940. Trying to prop up the status quo with single variable fixes cannot increase productivity beyond the practical upper limit of the traditional school model. Fixing one school by changing principals does not improve the overall performance of a district.

The Implementation Problem

Regardless of how many new research-based programs for improvement of public education are discovered and offered, they are regularly rejected at local levels. Sometimes they are rejected because of disagreement; sometimes because of ignorance. From the standpoint of trying to make improvements, neither excuse is forgivable. If the same practices were followed in medicine, or engineering, or other major professions, there would likely be a landslide of lawsuits charging malpractice (Stewart, 1971). Failure to take prudent action is just as professionally irresponsible as taking incorrect action.

Implicit Models

When considering how one must make changes in public education, keep in mind that all of the people who manage the schools and districts, in which new programs could be implemented, have a strongly traditional concept of school operations, teaching, and administration. I call these traditional concepts an *implicit model*. It is implicit because one learns the proper traditional models, roles, and attitudes throughout academic life, incidental to learning the subject matter. As each of us experiences elementary school, middle school, high school, and post secondary education, we develop an internal reaction to them. These reactions are both intellectual and affective. The personal concept of the good and bad features of our personal schooling are true for us, but these impressions are not the correct data-source for developing valid knowledge. It is most likely that our personal experience base is not as accurate as the more objective empirical base, but, we tend to trust our own intuition, nevertheless (see Lerner 1985 for an elaboration of how these early experiences dominate our thoughts and behaviors).

We must find a way to bring the available research and technology in the behavioral, management, and communications sciences to bear on the school problem.

Explicit Models

Change models (Burkman, 1987), instructional systems development (Branson & Grow, 1987), and other approaches for improving instruction (Gagne & Briggs, 1974), improved management approaches, such as differentiated staffing (English & Sharpes, 1972), and well managed peer tutoring are all *explicit* models, because they clearly indicate both the form and the content of the intervention in the specifications.

Teachers and administrators do not know in advance, or solely from past experience, what is to be called for in the new approach. Training is required. How many times have you heard, "Why, there is nothing new about the systems approach—good teachers have been doing that all along." And, from Statistics 101, you also know that half of the teachers are below average; at least half of them have not been following reliable, empirically developed practices on their own, nor have they been *managed* to do so.

Systematically designed models and applications of research-based solutions always require approaches to instruction that differ from the traditional school model. That is not at all strange. We do not expect people to have known research outcomes prior to the time that the research was done. School administrators are not likely to have experienced any systematically designed courses or curricula. Most of them will have gone through traditional schooling in elementary, middle, high school, and college and they will consider any variation in the implicit model of instruction or management system to be abnormal, improper, and perhaps unnatural. Without effective management, they will not be able to imagine systematic design and operations as an important method of improvement.

If one accepts the practical upper limit hypothesis, probably the most seductive and most seriously erroneous idea that surfaces from time to time, is that somehow educational system improvements can be made by improving preservice teacher training and increasing the salaries of the incumbents. Why blame the teachers? The amount of variance that could be accounted for on the basis of improved teacher-training for the current operations model is probably of the same percentage magnitude as can be obtained by the piston engine aircraft operator who waxes the wings. Wing-wax and teacher-training do not account for a large percentage improvement. Teacher-training is a typical and naive single variable solution.

If there is no management structure in place to insure that effective and

proper treatments are applied to all students consistently, it really makes little difference what preservice training is given to teachers. When individual teachers and principals can decide whether they offer good quality instruction, no one can be sure of getting it.

Fundamental to the notion of the implicit model of instruction is the concept of the "classroom." In my view, the fact that the classroom model (one teacher, one class, one room) still operates when we have solid empirical evidence about school learning and other variables known to impact student performance, including basic classroom management techniques, is a preservation of the past and clear evidence that the system must be changed. The classroom concept is archaic and should be abandoned in favor of a school environment that has been designed to serve specific purposes set forth in the system requirements. The design should provide for individual learning, space for group processes, and should be organized according to its function, not vice versa.

Some people believe that Jefferson's insistence on decentralized control of education is responsible for the survival of the Republic. Others believe that it is a terribly high price to pay for freedom. The problem for which decentralized education was the solution has been over for one-hundred years, the real threat in this century has been from abroad. Unfortunately, the price is getting so high that we can no longer afford it.

Conclusions

1. Based on the available evidence reported in the literature, both popular and professional, there is indeed a discrepancy between the expressed needs of the society and the productivity of the schools. There is a critical requirement for substantial improvements in performance.

2. The research literature has provided numerous tools and approaches to improve existing practice in instruction, socialization, and custodial functions which are all critical to school operations.

3. The organizational and management structure is based on a model that has been obsolete for many years and which is totally inadequate to operate and control the large and complex required programs necessary for improvement.

4. The existing management, operations, and instructional models have completely matured. Their productivity function is near the attainable upper limit; little further improvement can be made without fundamental redesign.

5. All other major operating sectors in the society have had to incorporate technology to meet the increasing demands for service and products. Many of these sectors have gone through several generations of technology to meet the nation's needs (manufacturing, communications, services), while the schools persist in adhering to an archaic model.

6. Recommendations provided by national commissions and conventional fixes proposed by members of the establishment have uniformly urged putting more effort into the status quo. Suggestions such as increasing standards for teachers and students, paying incumbents more money, increasing per pupil expenditures, and lengthening school days and years, will add to costs but cannot add substantially to benefits.

7. It is essential that the entire establishment go through a fundamental redesign to define mission and system requirements, then develop empirically based methodologies to meet those requirements.

8. As long as there is no externally imposed requirement for change, school administrations will not change. There is now no known way to cause the necessary and sufficient changes that would make a significant difference.

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