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EDUCATION

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Abstract

For the past twenty years policy initiatives at the state and federal levels have reflected the call for significant improvement in educational outcomes to support the human capital needs of the 21<sup>st</sup> century. An argument is presented on the basis of longitudinal data that the basic structure of the current system of education undermines national efforts to improve levels of academic achievement for underperforming students. A brief outline of an alternative structure for the education system is provided that might overcome the limitations of the current factory model.

Descriptors

Student characteristics  
Testing  
Academic Achievement  
Educational Assessment  
School Effectiveness  
School Statistics  
Educational Change  
Elementary Secondary Education  
Public Schools  
Mastery learning

## **OVERCOMING THE LIMITATIONS OF THE FACTORY SYSTEM OF EDUCATION**

In 1983 the Nation at Risk Report cemented the role of human capital development as a central theme in state, national, and international education policy. With their claim that American education was suffering from a “rising tide of mediocrity” that threatened the nation’s economic standing in the global economy, the author’s of a Nation at Risk had a profound effect on the debate about the quality and direction of the education system. A central tenet of this report is that for America to retain its privileged position in the global economy, 80% of its students had to achieve the educational outcomes traditionally reserved for the top 20%. This new imperative, education for (almost) all, has become central to major policy initiatives at all levels of government. For instance, in 1990 the nations’ governors developed Goals 2000 which among other things declared that:

- By the year 2000, U.S. students will be *first in the world* in mathematics and science achievement.
  
- By the year 2000, every adult American will be literate and will possess the *knowledge and skills necessary to compete in a global economy* and exercise the rights and responsibilities of citizenship.

President Bush’s policy initiative No Child Left Behind (NCLB) echoes these themes with statements justifying the policy such as:

Satisfying the demand for highly skilled workers is the key to maintaining competitiveness and prosperity in the global economy....A recent report found that raising student achievement directly leads to national economic growth. The report estimates that "significant improvements in education over a 20-year period could lead to as much as a 4 percent addition to the Gross Domestic Product" or over \$400 billion in today's terms.

([http://www.ed.gov/nclb/overview/intro/guide/guide\\_pg3.html#econ](http://www.ed.gov/nclb/overview/intro/guide/guide_pg3.html#econ), 11/13/04)

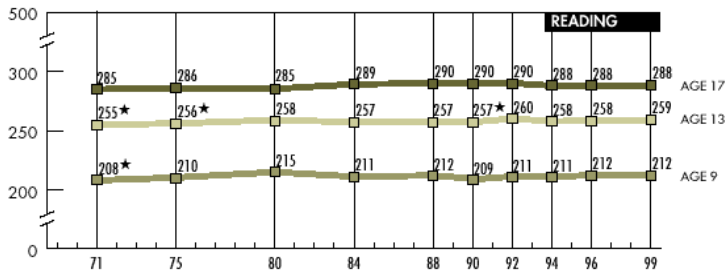
The consistent theme underlying these policy initiatives is the need for high standards and outcomes that represent a shift from a system that ensures educational winners and losers, to a mastery learning model in which virtually all students master the rigorous academic content. Mastery outcomes such as those advanced by NCLB require a system that supports mastery learning. There are substantive structural barriers to achieving mastery outcomes in the existing age-cohort system. Before addressing how the system could change to better reflect the requirements of a system of mastery learning, it is worthwhile to examine the evidence regarding the ability of the current system to meet the challenges put forth in NCLB legislation, and other policy initiatives reflecting the Nation at Risk imperatives.

### **The Effects of Three Decades of Reform 1970-2000**

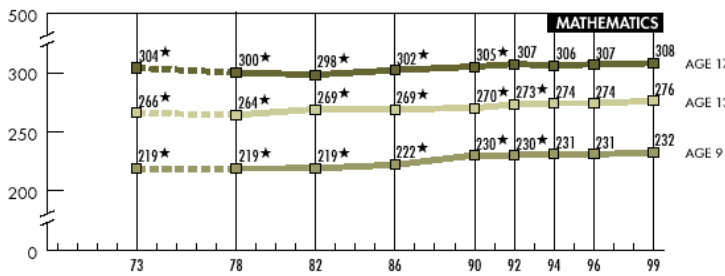
The National Assessment of Education Progress (NAEP), a national data collection system that has been monitoring educational outcomes since 1969, measures literacy, mathematics, and science outcomes among others. The following written

summaries and tables are taken from the NAEP website. In the interest of brevity and clarity the written summaries only include the analysis of student outcomes of the middle group at age 13. The accompanying graphs illustrate the similarities at all three age levels and any of the three ages would have yielded generally similar results as to the changes in student outcomes between 1971 and 1999.

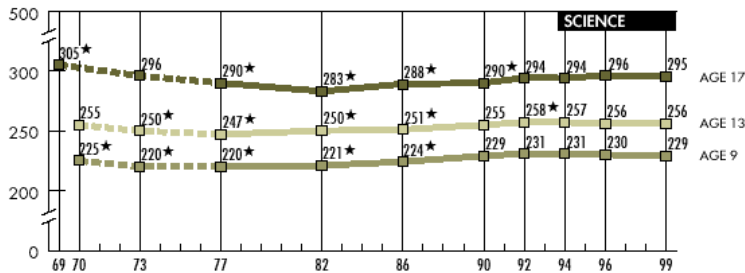
- **Reading age 13.** Average scores increased during the 1970s. Since 1980 scores have fluctuated so that no further improvements in reading scores have been evident; however, the average score in 1999 was four points higher than that in 1971.



- **Mathematics age 13.** An increase in scores between 1978 and 1982, followed by additional increases in the 1990s, resulted in an average score in 1999 that was ten points higher than that in 1973.



- **Science age 13.** After declining between 1970 and 1977, average scores increased until 1992. A slight decline since 1992, however, resulted in an average score in 1999 that was similar to that in 1970.



NAEP Nation's Report Card 2000

The NAEP data shows how little national achievement levels have changed over the past several decades. Of the three areas reported averaged across all three age groups, only mathematics improved between 1971 and 1999; and there, the improvement was nine points over thirty years on a 500 point scale. The overall average improvement for all ages across the three subjects was 3.5 points.

Despite the lack of improvement in national outcomes, some states have reported relatively robust gains from their testing and accountability initiatives (e.g., TEA, 2000). These results are often touted in political contests. However, independent research has identified very few instances of significant gains in educational outcomes at the state level. Independent studies generally find the reported gains illusory, often more a result of who is and is not tested, test effects, or how students are assigned to different grade levels for the purposes of examination (Amrein-Beardsley & Berliner, 2003). For instance, Linton & Kestler, (2003) compared gains on the Texas Assessment of Academic Skills (TAAS) and the scores from the Metropolitan Achievement Test (MAT-

7) which is designed to test more generalizable academic achievement in math and found that that state's results significantly exaggerated the achievement gains. The reported improvements in student outcomes turned out to be a result of teaching to the test rather than mastering mathematical skills. Furthermore, the NAEP data, the only consistent measure across the past few decades, strongly suggests that general skills in math, science and literacy have improved little for the nation as a whole (NAEP, 2000). While average scores are important, the true measure of success in meeting the challenge set forth in A Nation at Risk and NCLB is how well we are closing the gap between the top 20% and the rest of the student body. There is every indication that the nation's top 20% have an education that allows them to compete globally. It is the students who are not reaching those levels that are of concern to the authors of A Nation at Risk and subsequent policy makers.

In analyzing the distribution of achievement within an age group, the NAEP data is reported using four levels of achievement: below basic, basic, proficient, and advanced. Basic and below basic indicate students have not mastered grade level curricula. Those that fall into the proficient or advanced categories have mastered or gone beyond the grade level requirements. As above, in the interest of brevity and clarity the following information reports NAEP results for only one of the three grades tested, although any of the three would show approximately the same pattern.

In examining current NAEP data on how well 8<sup>th</sup> grade students are mastering grade level standards the results are as follows: in reading 26% are testing below basic, 42% at basic, 29% at proficient, 3% advanced. This indicates that only 32% of students are performing at or above grade level in reading. In mathematics, 32% are testing below

basic, 39% at basic, 23% at proficient, 5% advanced. In science, 39% are testing below basic, 29% at basic, 28% at proficient, 4% advanced (NAEP 2003, scores for 8<sup>th</sup> graders. <http://nces.ed.gov/nationsreportcard/>, 4/12/05) Similar patterns were reported for the other two grade levels measured.

With 68% to 78% of students (depending on subject area) currently falling below grade level standards, for 80% of today's students to perform at the same level as the top 20% did in 1983 (the year the challenge was set by the Nation at Risk report) would require an unprecedented improvement in educational outcomes. This outcome is a dramatic and perhaps wildly optimistic escalation of the demands on the current education system. Based on quartile reports, given the rate of improvement in reading skills reflected in the NAEP data over the past 20 years, it would take nearly 90 years to accomplish this goal. In math it is better; the approximate score of the top 20% in 1983 was 245. For 80% of the students to reach this level requires that students scoring 190 in 1983 would have to score 55 points higher. Between 1983 and 2000, there was a mean gain of 13 points for the bottom quartile. In mathematics it would take just over 70 years assuming the current trends could be maintained over that time (NAEP, 2000). In science the results are similar.

Frustrated with the lack of improvement in traditional school systems, a number of market inspired initiatives have been tried. Advocates for privatization and charter schools point to anecdotal studies supporting those reforms, but in these cases independent analysis of standardized test data have not supported claims regarding improved student achievement. Studies of privatization have shown little improvement



in educational outcomes and few if any of the promised efficiencies (Nelson & Van Meter, 2003; Fitz & Beers, 2002). While charter schools have had relatively little time to realize the promised outcomes, the best data currently available show no gain in academic outcomes for those charter schools designed to mirror other public schools, and significant drops in achievement for alternative, non-classroom based charters (Nelson, et al., 2004; RAND, 2003).

Why are the system's outcomes so resistant to reforms? It appears that despite the threats of sanctions, promises of rewards, opportunities to diversify and the imposition of market forces, the system stubbornly clings to the same pattern of outcomes. This is not to say that the system has not changed or improved. Over the past hundred years the provision of education expanded dramatically. In 1900, there were only 630,000 students in secondary schools, about 10% of the school age population. By the 1990's there were 15 million or 94% of the population between the ages of 15 and 17 (NCES<sub>b</sub>, 2004). Since 1900, teachers have become better educated, pedagogy has become more sophisticated, and instructional materials have become more engaging (Cohen, 1987). While the system has improved, the changes in society have outstripped the system's ability to meet changing expectations. The current system of education is little closer to achieving the "educational for all" goals than it was in 1983. Perhaps the most remarkable result from the NAEP data is how stable the outcomes have been despite waves of reform, and billions of dollars in federal, state, and local initiatives.

One explanation for the NAEP results is that the system itself is designed to produce the outcomes reflected in the data. The following section will present an argument that the very design of the current education system is responsible for the lack

of progress, and that asking the current system to produce mastery-type outcomes, where virtually all students master a rigorous curriculum, is like asking a rock crusher to produce polished diamonds. It is simply the wrong tool for the job.

## **Exploring the Causes of the Failure of the Current System to Meet 21<sup>st</sup> Century**

### **Demands**

At the turn of the last century, to facilitate the training of workers needed for the growth of mass production industries and to accommodate the popular demand for education, the nation's educational institutions were gradually transformed from the one room school house to a system built on a mass production model. The shift was an example of how business models are sometimes applied to education. Having proven the power of mass production models during the civil war and with the rapid growth of industry in the waning decades of the 19<sup>th</sup> century, the "factory model" of education seemed to promise similar efficiency and effectiveness in meeting the challenges of a growing nation.

During the late 19<sup>th</sup> and much of the 20<sup>th</sup> century America's economic power was built on smokestack industries that conformed to a general pattern. A relatively small number of management/professional jobs that required the advanced academic skills to conceptualize, organize, design, manage and account for production activities; the majority of the workforce were educated with basic literacy skills, an ability to follow directions, job specific skills (e.g., assembly line worker), and having acquired the basic employment skills of punctuality and respect for authority; the remaining few with little or no education were required to provide a workforce for menial labor. This pattern is

roughly reflected in the NAEP data measuring educational outcomes (i.e., levels of below basic to advanced) and is much the same today as it was thirty years ago when the national data started being collected. The system is designed to produce these results, and no reform that leaves the current structure intact has so far been able to substantively change these outcomes.

In the past few decades we have gone from an industrial society to an information age, from local standards to global standards, from Taylor's industrial model to quality organizations with flattened hierarchies and employees who make substantive decisions in the production process. Business leaders and politicians have demanded that the education system find ways to meet these changing expectations, generating demands on the educational system that have escalated dramatically. Given the lack of results of two decades of reforms so well illustrated by the NAEP data, it is reasonable to conclude that the current system, built on the technology of the 19<sup>th</sup> century, does not have the capacity to keep up with modern demands of a global information age. The questions are: what needs to change, in what ways, and to what extent?

### **The Factory Model of Education**

Over the past couple of decades of reform, teacher preparation, pedagogy, curriculum, assessment, class scheduling, etc, have all experienced waves of reform. The only aspect of the system that has not been reformed is the structure of the system itself. The current "factory model" is a time-based age-cohort structure that conforms ideologically and structurally to the mass production model that powered the nation into the 20<sup>th</sup> century. At its core, the model is built as an assembly line. The raw material,

children, enter the system at a predetermined time in their lives and move from unit to unit on an annual basis until they have completed twelve years of schooling. At this point the finished product is graduated and sent out into society. At the turn of the last century this model was embraced by the nation. One of the leaders in this movement was Ellwood Cubberley professor and dean of the School of Education at Stanford who applied industrial management theory to create the “science” of school management giving rise to modern school administration (PBS, 2005).

“Our schools are, in a sense, factories in which the raw products (children) are to be shaped and fashioned into products to meet the various demands of life. The specifications for manufacturing come from the demands of the 20th-century civilization, and it is the business of the school to build its pupils to the specifications laid down. This demands good tools, specialized machinery, continuous measurement of production to see if it is according to specification, the elimination of waste in manufacture, and a large variety in the output.” (Cubberley 1916, quoted in Clinchy, 1998)

Due to this factory structure, every child, regardless of privilege or personal challenges, has one academic year to master as much of the grade’s curriculum as possible before being pushed to the next grade. Only the most “defective” units do not progress. Indeed, if too many students are not allowed to pass to the next grade, it is seen as a sign that the system is failing or that the teachers did not do their job. These forces

and the uneven distribution of physical and human resources lead to the “large variety in the output” Cubberley describes as a central goal of the factory system of education.

Today, with the need to reduce the disparities in educational outcomes in order to meet the higher demand for education inherent in a modern economy, the goal of providing effective education for “all” requires the system to do something it was not designed for.

The consequence of the age-cohort, factory model is that early deficits are compounded with disadvantaged children falling further and further behind (Elkin, 2001; Rist, 1973). Attempts to hold schools accountable for high standards fail because the variation in students, their social support, cultural capital, attitudes about learning, levels of intelligence, and academic deficits overwhelm the ability of schools to address the challenges caused by that variation. Furthermore, students quickly learn that even a bare minimum of effort allows them to progress through the system to the next level, just as teachers learn that their job is to pass students through.

Current efforts to end social promotion on the basis of testing suffer from the fact that no system that holds back a majority of students can withstand the political pressure built into an age-cohort model (see Kilpatrick, 2001). In a factory model, progression with one’s peers is seen as a right rather than an earned privilege. Furthermore, studies examining the academic trajectory of those held back a grade routinely show that this increases the rate of failure rather than improving the students’ outcomes (Jimerson, 1999). Given the current evidence, it may simply be impossible to achieve the desired mastery outcomes with an age-cohort factory system. As a result, standards are lowered, and educators blamed, punished, and replaced, with little effect.

As described above, the current age-cohort model gives each student one year to master as much of the curriculum as they can before progressing to the next. Students who learn more slowly learn less in a year's time and therefore progress to the next year with a competitive disadvantage. This competitive disadvantage is extended and institutionalized as the student progresses through the years. As students develop self-identities as learners in a competitive system, those who fail to compete effectively withdraw effort in order to protect self esteem. The more one tries and fails, the more it appears that he/she is not capable. Better not to try, and then blame failure on a lack of effort rather than accept that one is not "smart" enough to compete (Ames, 1984). Unfair competition, as exists in a system that provides the same time for everyone despite their relative advantages/disadvantages, leads to learned helplessness and a lack of success oriented motivation. Furthermore, a system that requires students to progress to the next grade at a rate which exceeds their rate of learning undermines success at each subsequent level. In this way, the very students who are targeted by current legislation, the ones that need to greatly improve their academic skills to meet the challenges set forth in the Nation at Risk report and subsequent legislation are undermined by the current factory model.

The distribution of outcomes from the current educational system is largely a reflection of the social economic status of the students who enter. Children who face more challenges at home take longer to learn. This puts them at a competitive disadvantage in an age-cohort factory model which is often reinforced by mechanisms within the system itself. For example, in his seminal work, Rist (1973) found a set of culturally biased assumptions held by teachers that led to differential opportunities for poor children, with

the consequence that “school as an institution sustains, in a myriad of ways, the inequalities with which children first come to school” (p.242). A lack of social capital, the lack of educational success of their parents (Ferguson, et al., 2001), their difficult fiscal circumstances (Orr, 2003), or the uneven distribution of resources to schools (Kozol, 1992) have all been found to affect students’ academic achievement. Elements of the school system combined with the increased needs and reduced resources of some students contribute to the uneven distribution of educational success. And while IQ is a strong predictor of educational outcomes, its effects are less than those of social factors (Bowles and Gintis, 2002). Privileged students make up the bulk of the top 20% while underprivileged children fill out the bottom ranks.

Whether one accepts the argument that the system is deliberately designed to protect the social status quo (Bowles and Gintis, 1980) or assigns the inequities to an uneven distribution of resources, both physical and human (Kozol, 1992), the fact remains that what the system produces is best predicted by the social and family characteristics of the students it takes in. The result is a tremendous waste of human potential as the success of capable students is undermined in the current system.

As Joseph Juran and Edwards Demming, two of the most influential gurus on organizational quality conclude, 90% of an organization’s problems with quality output are related to the system, not to the people struggling within it. Holding teachers and administrators responsible for the failure of the system is to misunderstand the nature of the problem and to ensure another decade of failure to raise student achievement. The limitations of the current competitive system result in an inability to provide the

“education for all” required to preserve America’s economic power in the information age. The results are also simply unfair.

### **A Unique Opportunity**

Educators have long argued for more equitable outcomes, advancing the egalitarian ideal that schools should be a place where all students rise to their potential unrestrained by the biases of the larger society. And while Rist (1973) and others have responded that schools, enmeshed in that broader society, can do little more than reflect its inequities, the moment has arrived when the moral imperative of equal education meets the economic imperatives of human capital development in the modern age. As long as the 20-60-20 outcomes served the interests of the economically and politically powerful and their factories, there was little hope of generating the resources and political commitment to fulfill the egalitarian ideal. Today however, for different reasons, we find ourselves in some agreement that reforms need to occur that will allow virtually all students to fulfill their potential in reaching the educational outcomes of the top 20%. The question is how?

### **Elements of a Solution in Overcoming the Limitations of the Current Factory System of Education**

Achieving mastery type outcomes where virtually all students master rigorous curricular goals requires a mastery learning system. In the current system, students begin being sorted in kindergarten, by the time they reach high school, the compound effects of early struggles, leaves them with few academic skills and fewer options in terms of the



curriculum. This results in a massive waste of human potential and the economic benefits that would be available if those students could be educated in accordance with their innate potential. The current system has not demonstrated the capacity to significantly improve student outcomes. In international comparisons American students test poorly compared to many other industrialized nations.

As business leaders discovered in the 1970s and 80s, competing on the basis of mass production is a race to the bottom. To compete at higher levels in a global economy requires a shift from mass production systems to quality production systems. These new business models reflect the essential elements of a mastery learning system in which quality is monitored and built into each stage of the production process. A fresh approach to educational systems that emphasizes mastery rather than mass production is required to provide an education that addresses the economic and political needs of preparing an effective workforce for the information age of the 21<sup>st</sup> century. We have already seen three decades of significant investments in educational reforms with little improvement in academic outcomes. To substantively improve the outcomes, the system itself needs to be redesigned.

The following list provides some basic requirements of a revised system that can overcome the limitations of the current factory model:

1. The age cohort model that creates an entitlement process and forces the vast majority of students to move from one level to the next in lock-step must be replaced with a competency cohort model in which students have the necessary time to master the skills and knowledge at each level so that they are fully prepared before moving to the next level.

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2. The structure of the system's levels and the process of moving from one level to the next must be redesigned to mitigate the negative effects currently associated with remaining behind as others in an age cohort move to the next level.
3. The current competitive system creates early winners and losers leading those who learn more slowly to withdraw effort. This results in learned helplessness and exacerbates early inequities. Replacing the current system with a mastery model, in which students learn that effort and success covary will reduce learned helplessness, increase student motivation, and result in higher levels of achievement when combined with flexible time allotments. .
4. By shifting from seat time (e.g., one year in third grade) to mastery, the relationship between students, teachers and parents change. Students can no longer wait out a class they do not like, teachers can no longer give up on a student who consistently fails to complete homework, and parents can no longer assume their child has the right to move to the next grade at the end of the year. A mastery model, based on comprehensive assessment, puts the focus on learning and creates an entirely new dynamic in the classroom in which everyone involved has a new imperative to help each student master the curriculum.

The current system of education, based on the technology and business models of the late nineteenth century is no longer adequate to meet the changing needs of the 21<sup>st</sup> century. Billions of dollars have been spent trying to get the system to do things it was never designed to accomplish. To meet the human capital needs of a global information age, and to mitigate the inequities inherent in the current system requires a redesign of the

basic system itself. A shift from the factory model of mass production to a mastery system of quality production is essential if the United States is to maintain its economic viability and promote the quality of life we desire for all of its citizens.

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