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Industry Study

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Education Industry

The Industrial College of the Armed Forces
National Defense University
Fort McNair, Washington, D.C. 20319-5062

EDUCATION 2006

ABSTRACT: The education industry is vital to United States (U.S.) national security as it is largely responsible for generating the human capital necessary to effectively integrate the various instruments of power to promote U.S. national interests. An educated workforce and citizenry contribute to the economic and political well being of our democracy. The U.S. education system has been the cornerstone of the world's largest and most powerful middle class, capable of sustaining the world's highest per capita Gross Domestic Product. The U.S. education system is currently producing mixed results within its mission of ensuring that the U.S. workforce is able to maintain its high standards of living and technological edge in a rapidly growing, globalized, and competitive environment.

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PLACES VISITED

Domestic

American Federation of Teachers, Washington, DC
Boston Renaissance Charter School, Boston, MA
Chelsea High School/Boston University Partnership, Boston, MA
Council of Great City Schools, Washington, DC
Department of Defense Education Activity, Washington, DC
General Motors University, Detroit, MI
Harvard University Graduate School of Education, Cambridge, MA
Home School Legal Defense Association, Purcellville, VA
Houghton-Mifflin, Inc., Boston, MA
Maryland State Department of Education, Baltimore, MD
Minuteman Regional High School of Applied Arts and Sciences, Lexington, MA
Montgomery County Public Schools, Rockville, MD
Mountain View Alternative High School, Centreville, VA
Northern Essex Community College, Haverhill, MA
Phillips Academy, Andover, MA
Potomac Job Corps Center, Washington, DC
Raytheon Corporation, Waltham, MA
Thomas Jefferson High School for Science and Technology, Alexandria, VA
U.S. Department of Education, Washington, DC
World Bank Human Development Network, Washington, DC

International

Baden-Wurttemberg Schools, Stuttgart, Germany
Department for Education and Skills, London, England
Deutsche Bank, Frankfurt, Germany
EADS Corporation, Ulm, Germany
Enfield County Schools, Enfield, England
Goethe Gymnasium, Frankfurt, Germany
Tiffin Girl's School, Kingston, England
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INTRODUCTION

The U.S. education system is responsible for the development of human capital necessary to create and maintain the nation's standing as the world's economic and technological leader. The educated and innovative populace of the U.S. has built the world's most prosperous nation. Today, there is much concern that the U.S. may be failing to maintain its global leader position due to low performance in some segments of the U.S. education system. Many question whether the U.S. education system is capable of meeting expectations and producing students who can sustain the U.S. economic and technological power in the international market place.

In his national bestseller, *The World Is Flat*, Thomas Friedman argues that the U.S. must run faster to maintain its standing in the world. Friedman's advice to his children is to "finish your homework as the people in China and India are starving for your jobs" (Friedman, 2005, p.237). The U.S. education industry has a vital role to play in national security, preparing the U.S. workforce and the nation to participate and lead in the global market with rapidly advancing technologies. The Education Industry Study examined the U.S.'s ability to meet this challenge.

The Education Industry Study met with education experts and practitioners from across the country, including local, state, federal, and foreign government officials, corporate executives, and private education and interest group leaders. The Industry Study gained extensive insights into the issues and policies of the education industry and explored a wide variety of topics. Each member of the Industry Study conducted a research project, which covered the gamut of important issues within the education industry, many of which are included in this paper.

Initially this report defines the U.S. education industry as it exists today. It then focuses on four key issues: America's global competitiveness in education, implementation of the No Child Left Behind Act (NCLB), teacher workforce issues, and vocational education. Each of these four key areas will be addressed with regards to their current condition, challenges, outlook, and pertinent government recommendations. The report also includes an overview of the English and German education systems and how these systems compare and contrast with the U.S. model.

THE INDUSTRY DEFINED

The U.S. education industry is a key contributor to national security with responsibility for providing the intellectual capital to fuel the nation's economy, driving U.S. competitiveness, developing an informed citizenry and providing for the national defense. The definition of the education industry encompasses multiple segments. The sector most Americans are familiar with is public education, which includes pre-kindergarten, elementary, secondary, and higher education. Elementary and secondary institutions can be further defined by the subdivisions of traditional public, charter and magnet schools. States have the primary role for funding and executing public education down through the local districts, but the federal government still provides policy guidance and some funding for state education. Public school curriculum determination is most often left up to the local district level but in some cases has been consolidated and

dictated by the state to local districts. Complementing the public school sector are the private and religious school systems that provide pre-kindergarten, elementary, secondary, and higher education services as well as home schooling. A third sector of the industry is vocational and technical education that provides hands-on apprenticeship instruction intended to prepare students to become skilled laborers such as plumbers, mechanics and electricians. The final sector of the education industry is corporate training and education that is designed to enhance the professional development of each level in the corporate chain from assembly line worker to chief executive officer.

Education in America is big business. The Department of Education alone manages a budget of $88.9B helping to support over 94,000 public schools (ED.gov, 2006). Total enrollment in both public and private elementary and secondary education is currently topping 54 million students (Ibid). However, the majority of funding for primary and secondary education comes from state and local governments, who contributed 46% and 37% of funding in 2004-2005 respectively, with the federal government providing just 8.3% and private sources 8.9%. (Ibid)

International Comparison

The Education Industry Study visited England and Germany to compare and contrast education systems against the U.S. model. England employs a centralized system where the national government dictates curriculum, testing and materials down to the local level and provides 90% of all education funding. Unlike the U.S. system, there is little autonomy at the state and local level to alter central direction. The German model is very similar to the U.S. construct in that the state has the primary responsibility for all aspects of the education process. The German federal government does provide some funding to the states but very little if any policy direction. The one major difference between the German and U.S. model is that the German system decides when students reach the end of the 4th grade as to which educational track they will be placed in. Teachers recommend children for educational tracks that lead either to college, vocational training or basic education training. While the ability to change education career tracks is possible, there is typically little movement between tracks once a student is placed.

CURRENT CONDITION

Global Competitiveness

Today there is much concern that the U.S. education industry is falling behind by not keeping academic pace with its global competition. In October 2005, a special committee of the U.S. National Academies issued the report, "*Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*" (Barlas, 2006). This report concludes that the U.S. needs "better-trained, more technologically sophisticated workers and engineers" due to "the effects of globalization, which has produced a situation in which 'workers in virtually every sector must now face competitors who live just a mouse click away in Ireland, Finland, China, India, or dozens of other nations whose economies are growing'"(Ibid). According to the National Intelligence Council's

(NIC's) 2020 Project report entitled *Mapping the Global Future*, "China and India are well positioned to become technology leaders" (NIC, 2004, p.11).

These concerns are based in part on the emphasis being placed upon technology education in other countries when compared with the U.S. The NIC report states "[t]he number of U.S. engineering graduates peaked in 1985 and is presently down 20[%] from that level; the percentage of U.S. undergraduates taking engineering is the second lowest of all developed countries. China graduates approximately three times as many engineering students than the U.S." (NIC, 2004, p.112). In fact, more than half of the undergraduate degrees awarded in China are in the fields of science, technology, engineering and math compared to just 16% in the U.S. (U.S. Department of Education, Meeting the Challenge of a Changing World, 2006, p. 13). The international performance assessment tool, known as the Trends in International Mathematics and Science Study (TIMSS), revealed that U.S. students have been consistently outperformed in math and science by almost one third of the nations tested (NCES, TIMSS 2003 Results, 2004).

In January 2006, President Bush addressed this concern when he announced his American Competitiveness Initiative, a "broad package of proposals to increase investments in R&D [Research and Development], strengthen education, and encourage entrepreneurship and innovation" (Barlas, 2006). The package includes increased funding and permanent tax credit for critical basic research programs in engineering and physical sciences, training of 70,000 high school teachers in high school-level math and science Advanced Placement/International Baccalaureate (AP/IP) programs, and the production of 30,000 math and science professionals as adjunct high school teachers (Ibid). In a February 2006 press release, the White House announced a proposed 4.6% Department of Education budget increase, with new or additional funding being specifically targeted for American Competitiveness Initiative programs (ED.gov, 2006).

No Child Left Behind Act

In 2001, the President was successful in passage of the NCLB Act of 2001, a bipartisan solution for education based on accountability, choice, and flexibility in federal education programs (ED.gov, 2005, p.1). NCLB is meant to spur improvement, encourage reform, and inspire new initiatives so that every child, regardless of race, ethnicity, socioeconomic status, disability, or level of English language proficiency, has the opportunity to achieve and be successful. NCLB provides historic levels of resources and flexibility to improve results for all children, especially for those who may need extra assistance meeting grade-level standards (NCLB Act 2001 Report to Congress, 2005, p.1). The NCLB Act is built around five key points: increased accountability, more choices for parents and students, greater flexibility for schools, putting reading first, and improved teacher quality (ED.gov, 2005). Each of these key points has important characteristics that, when successfully executed, will enhance the education for all students. But each of these aspects also represents challenges to the states as they strive to implement NCLB. The Act is currently in its fifth year of implementation with a current goal of having all children meeting proficiency goals by 2014. NCLB is due for Congressional reauthorization in 2006.

Teacher Workforce Issues

The NCLB Act also recognizes that good teachers are paramount to the success of U.S. public schools—in fact, Title II of the law requires that every classroom have a highly qualified teacher by the end of the 2005-2006 school year. However, a growing shortage of these skilled teachers jeopardizes the quality of education in U.S. schools today. Many school districts are forced to hire unqualified teachers to fill teaching shortages as the demand for teachers continues to rise because of retirements and career changers leaving the profession for higher-paying jobs. At the same time, the supply of teachers coming out of universities is not able to fill the gap. With the U.S. Department of Education estimating that school districts will need to hire more than two million new teachers over the next decade (Hussar, 1999), the recruitment and retention of teachers is indeed at a critical juncture. Current shortages of licensed teachers are most severe in traditional high-demand areas such as special education, mathematics, science, bilingual education, and technology education--and it will only worsen in the coming years (American Association for Employment in Education, 1999).

Coinciding with the issue of recruiting and retaining quality teachers is the role of teacher unions, which remain a powerful presence in U.S. education. While critics question whether unions sometimes place their own concerns over the cause of improving student performance (Wossmann, 2003), teacher unions respond they have long embraced a dual nature as a labor advocate for teacher careers while simultaneously promoting improved professional standards. The inherent tension between these two roles often complicates the effectiveness of school reform initiatives at the local level, especially in states without “right to work” laws. Even so, unions increasingly recognize a fundamentally altered environment where traditional zero-sum collective bargaining models used in the past no longer produce the same gains, and more crucially, realize that education choice alternatives are increasingly popular with the general public. An emerging “new unionism,” as it is loosely described, reflects a common commitment for improved service to the school system (Kerchner, 1997) with a renewed focus on student achievement. How this new union vision plays out will likely impact recruiting and retention of quality teachers, and be a critical factor in the successfulness of NCLB.

Vocational Education

Just like teacher unions, vocational education is struggling to find its place in the U.S. education system. Administrators are being pulled by those who believe this style of education should provide a path to direct employment versus those who question whether the continued support of vocational schools is warranted in the wake of globalization and the need for a more technically skilled workforce. Vocational school programs at the high school and community college levels are characterized by a more hands-on, often blue-collar approach to learning that prepares the student for direct-entry into the workforce. However, the basic concept under which vocational schools exist is now the very same reason they are struggling as they try to strike a balance between the trade skills they teach against educational standards and the demands for a more highly technically skilled workforce.

Compounding the issue is the continued identity problem these schools face, which are often viewed as a dumping ground for students "not as capable" as those attending more traditional colleges (Flagg, 2006). In fact, the somewhat negative view of vocational education has resulted in the U.S. Department of Education referring to it as Career and Technical Education (CTE). Minuteman High School, a highly successful vocational school outside Boston, is representative of this effort at adaptation as it now describes itself as a School of Applied Arts and Sciences. These are simple but telling changes.

CHALLENGES

Global Competitiveness

The U.S. education industry is challenged to improve student performance to grow the nation's ability to intellectually compete for economic and technology superiority in the international market. However, it is difficult to determine the ideal indicators of either success or failure, and how to best hold the educational system accountable for producing results. Moreover, performance indicators vary across socio-economic and other demographic sub-groups as well as among urban, rural and suburban schools. Statistical data within the educational industry can be manipulated to support or contradict almost any hypothesis regarding the state of U.S. education and the performance of U.S. students compared with those of other nations (Bracey, 2005, pp.142-143). Today, the press is filled with countless claims of the inferiority of U.S. student performance based on international test results and the declining number of advanced technical degrees in the U.S., calling for increased standards and accountability. However, a Duke University study found that engineers are defined differently, yielding statistics that other nations are graduating more engineers than the U.S. (Fuller, 2006). As the U.S. moves towards increased standardized testing for accountability, other countries that have adopted standardized test-oriented education systems have realized the shortcomings of "teaching to the test" (Rotberg, 2005). Such methods may in fact produce higher test scores, but do they produce a more productive or innovative workforce (Ibid)? While it will be a challenge to ensure U.S. students remain competitive in a globalized workforce, it will also be a challenge to accurately determine the state of our global competitors and if increased standardized testing of the NCLB Act is the answer to producing more positive results.

No Child Left Behind

Testing requirements under the NCLB Act have been criticized for driving up educational costs at all levels of government. For example, the National Education Association (NEA) has stated that NCLB is seriously flawed and under funded (NEA, 2005, p.1). Utah and Connecticut are leading about a dozen states protesting that the NCLB Act imposes costly state obligations without the funding to carry them out (Source Watch, 2005, p.1). A second issue with NCLB is the growth in standardized testing to evaluate NCLB progress. The cost for testing is expected to rise to over $1.9B in the next

six years, and supply is struggling to keep pace (Olson, 2004). This growth in testing has created challenges in preparing representative tests that meet varying state standards and objectives, and preventing costly mistakes in scoring while at the same time reducing the time it takes to provide the ensuing reports (Toppo, 2006). A third issue complicating testing is when school systems and states are denied federal funds if they do not meet all student performance goals they establish. In the most recent National Assessment of Education Progress (NAEP) testing cycle, Mississippi reported close to 100% of their students meeting state standards and fully successful in math and reading. The NAEP results indicated that only 30% were fully successful against federal standards (NoChildLeft.com, 2005, p.1). This reality can push schools to set low, easily met standards to guarantee federal funding. A fourth challenge under NCLB is that public schools must report student performance by disaggregating the data by poverty, race, ethnicity, disability, and limited English proficiency (ED.gov, Executive Summary of the No Child Left Behind Act of 2001, 2005). Immigration has drastically increased the number of English-as-a-second-language students. The presence of large numbers of students new to English is hampering the ability of many schools to reach NCLB required proficiency levels in reading and math. For example, from 1990 to 2000 Arkansas, Alabama, Georgia and North Carolina saw an increase from 18,000 to 64,000 Spanish speaking students with limited English proficiency (NCELA, 2005). If proficiency goals are not met, federal funding is in jeopardy.

Teacher Workforce Issues

NCLB highlights the challenge to recruit and retain quality teachers at all levels in the education system. The number of teachers leaving the profession, up to 46% by some accounts (Ingersoll, 2003) in the first five years of teaching, is staggering. The reasons vary, ranging from inadequate planning time, heavy workload, and low compensation, to problematic student behavior and insufficient influence over school policy (Institute of Educational Services, 2005). These same issues also carry forward to the recruiting side as a significant number of college students, some of them potential teachers, perceive many of the same issues negatively (Education Commission, 2000). Overall, the supply of qualified teachers does not meet demand, resulting in school districts hiring less-qualified candidates to fill teaching vacancies and teachers often conducting lessons outside their field of expertise. The impact on students, as indicated by numerous studies, is lower achievement levels. The U.S. DOE estimates U.S. school districts will need to hire 2 million new teachers over the next decade (Hussar, 1999).

Notwithstanding the challenges of recruiting and retaining teachers, the current movement toward new unionism is timely, appropriate, and necessary. However, while it demonstrates that teacher unions are sensitive to both the “changing conditions of their profession and political realities” (Horn, 2002, p.105), the challenge will be how quickly and how well the unions are able to institutionalize renewed emphasis on teacher professionalism and student achievement. Otherwise, not only do teacher unions risk obsolescence, the teaching profession as whole, and ultimately the students and the nation, will suffer the consequences.

Vocational Education

The challenge for Career and Technical Education (CTE) institutions is to maintain their relevance and contribute to quality secondary and post-secondary education. To accomplish this, CTE institutions must adopt new methods for blending the traditional hands-on learning style with increased academic rigor. Complicating this end is growing pressure from the Bush Administration to reduce dedicated federal funding (under legislation known as the Perkins Act III) for CTE. Total CTE funding for fiscal year 2006 amounts to $1.3 billion, of which 10% is federal funding. An alternative High School Intervention Initiative proposal that would have diverted some of the CTE funding to dropout prevention programs and college prep for low income students was defeated when Congress voted to retain Perkins III. The Bush Administration's recent action to de-emphasize CTE is a good indicator of the continuing debates over the relevance of this aspect of education (CRS, 2006).

OUTLOOK

Global Competitiveness

In the short term, the U.S.'s ability to be competitive in the international job market remains relatively healthy. Despite student test scores, the U.S. is still competitive in science and technology. With only 5% of the world's population, the U.S. employs almost one third of all scientists and engineers and spends approximately one third of the global funds devoted to research and development (Domestic Policy Council, 2006, p. 5). However, there are worrisome indicators that not all elements of our public school system are producing an adequately educated workforce, while our global competitors continue to improve through education reform. While the U.S. public school system is slowly gaining ground in improving assessment scores and increasing accountability, the nation must implement strategic educational reforms to provide a well educated populace.

No Child Left Behind

The short-term outlook for NCLB is rocky as there are funding concerns that pit federal and state authorities at odds over who will pay for the requirements of NCLB. In addition, issues revolving around testing, English-as-a-second-language students, and realistic state standards must be addressed. From a positive perspective, each state has a plan outlining how they will achieve the goals of NCLB (Report to Congress, 2005, p.10). NCLB now requires performance reporting by demographic sub-groups and ensures schools employ highly qualified teachers using scientifically based practices in the classroom. NCLB has a strong Early Reading First initiative and measures overall student performance in grades 3-8. In the long term, NCLB will make the performance of U.S. schools transparent, allowing a clear picture of the country's progress in educating each child. NCLB has set the year 2014 as the year to have all children performing at

proficiency levels. Reaching all the goals of NCLB by 2014 appears to be an aggressive objective that, in all likelihood, will not be met in the next eight years.

Teacher Workforce Issues

While progress has been made in the last few years in recruiting and retaining teachers, in reality the work has only just begun. However, given the link between teacher quality and student performance, the emphasis to alleviate teacher concerns is sure to come. The greater cooperation from the unions that now exists is one indication of this. So too is the American Competitiveness Initiative proposed by President Bush in his 2006 State of the Union speech. ACI recognizes the importance of teachers through provisions such as the encouragement of 30,000 highly qualified mathematics and science professionals to become high school teachers by 2015 and the expansion of the teacher loan forgiveness program (ACI, 2006).

Vocational Education

CTE programs clearly have a role in the future U.S. education system. Thomas Friedman explains the need for a technologically savvy workforce through the example of farming--he describes today's farmers as not just laborers but technicians as well, who employ high tech applications including Global Positioning System technology for crop management (Friedman, 2005). The same is true in virtually every other industry as well, which gives credence to the development of high tech skills in the labor force.

In this technical world, CTE programs complement traditional higher education institutions and adapt by expanding their course offerings to find their niche in the expanding post-secondary high-tech education industry. And when they do, expect debates over their relevance and attempts to siphon off CTE federal dollars.

GOVERNMENT: GOALS AND ROLE

Global Competitiveness

Public schools in America are government-run near monopolies which have lacked accountability and are considered "under performing" when compared to past performance and current international standards. U.S. schools need increased accountability and applied pressure to facilitate better performance. **Recommendations:** One policy to address this concern is to expand school competition through greater use of charter schools which are publicly funded schools with more autonomy over operations than traditional public schools but held accountable for results in exchange for this autonomy (Zimmer & Buddin, 2006, p. 1). Another potentially promising competitive option is school vouchers. Vouchers are government funds provided to parents for competitive school selection (Bowsher, 2001, p.102). Although many competitive programs are in their infancy and still show mixed results, the Milwaukee Parental Choice Program for low income families, the nations largest and oldest school choice program, has demonstrated both improved academic performance and graduation rates

(Schoolchoicewi.org, 2006). Introducing competition into school selection is promising, but, implementing competitive school choice programs must be done methodically by measuring results and making constant adjustments to account for differences in regional school systems. Government supported competition within the U.S. public school system has potential as a strategic opportunity to improve student performance and accountability.

No Child Left Behind

The NCLB Act has demonstrated many successes but challenges remain. **Recommendation:** The federal government should thoroughly explore the controversy of state's claims for additional funding to meet all NCLB requirements that exceed existing state budgets. The federal government should also provide greater oversight and resources to standardize testing requirements of NCLB and raise the quality of current tests in use (Toch, 2006). The federal government should consider adopting the National Assessment of Education Program as the universal performance standard for all states as opposed to allowing each state to set their own performance metrics. In relation to immigration and the education of English-as-a-second-language students, the federal government must make adjustments to allow schools to separately report progress of this category of student to not unfairly impact overall performance metrics.

Teacher Workforce Issues

The federal government must provide clear, feasible guidance with the highly-qualified teacher provisions of NCLB to ensure understanding and compliance. In doing so, they must also work with the states to investigate new and innovative ways to compensate high-performing teachers and fix licensing and certification issues in order to improve the quality of teachers entering the classroom. **Recommendation**: All levels of government must continue the education of teachers through the expansion of professional development, on-the-job-training and mentoring programs for new teachers. In addition, more freedom must be given at the local levels to hire and fire decisions with cooperation from local teacher unions. Fortunately, this is beginning to happen via organizations like the Teacher Union Reform Network, which lists "reversing hostile labor relations" and transforming unions into "instruments of change" as two of its charter goals (TURN, 2006). Equally important, colleges and universities must do a better job in educating their graduating teachers (AFT, 2006). The key is for everyone, both inside and outside the government, to work together to address all areas of teacher recruitment and retention while keeping the individual student at the forefront. State government should lead this effort.

Vocational Education

Vocational education is a major part of the education system whose purpose is at a crossroads. **Recommendation:** The government should propose changes to CTE programs that better support NCLB academic requirements by increasing academic rigor

to go along with the hands-on style of learning. Changes should be modeled after the curriculum and instructional methods at places like Minuteman Regional High School in Lexington, Massachusetts and be an alternative for all students to help reduce the negative perceptions associated with CTE training. As part of this overall effort, specific job-training programs should shift from the secondary schools to the community colleges who already offer certification programs. It is essential that the federal government continue to provide funding for post-secondary CTE training at the community college level in order to meet the technological challenges in the global environment. Recognizing that it is more about priorities than it is about importance, current federal funding should, as a minimum, be maintained at its current 10% of CTE level, if not increased, through a re-examination of the Perkins Act to best support these new initiatives, to include the tertiary education programs.

CONCLUSION

There are many challenges that face the U.S. education system and its ability to provide the talent pool for our economic and security needs. U.S. global competitiveness and security are directly impacted by the viability of the U.S. education system. While the U.S. still maintains a position as a technological leader in the world, steps must be taken to ensure we maintain our lead. The American Competitiveness Initiative needs to be fully funded to incentivize math and science teacher training. In addition, the U.S. needs to expand competition in the public school sector through the increased use of charter schools and school vouchers to drive competition at the local public school level.

The No Child Left Behind Act has had a profound impact on the U.S. public education system. The federal government must find ways to fund requirements that exceed existing state budgets. In addition, the federal government must find ways to standardize and increase the quality of testing required under NCLB and consider setting the Federal National Assessment of Education test as the universal standard for state performance as opposed to allowing states to set and test to their own criteria.

Teacher workforce issues remain a challenging subject. Teacher shortages plague many areas often making recruitment and retention of teachers an insurmountable problem. Teacher unions also represent challenges when their goals of supporting teachers and students conflict. To address these issues, the federal government must provide clear guidance to ensure teacher qualification issues of NCLB are clearly understood and applied. All levels of government must explore innovative ways to compensate teachers and provide for meaningful professional development while finding common ground with teacher unions to balance the needs of teachers and students.

Finally, vocational education has taken on a new importance with the need for technical proficiency at virtually all levels of the labor force. Government policy should support academic rigor in all vocational training to ensure academic needs of NCLB are met. Policies should also work to overcome negative connotations associated with vocational training and provide adequate funding to maintain this type of education.

ESSAYS ON MAJOR ISSUES

U.S. NATIONAL SECURITY: THE SUPPLY AND DEMAND FOR AN EDUCATED MATHEMATICS, SCIENCE, AND ENGINEERING WORKFORCE

Introduction

The year was 1989 – the year the Berlin Wall came down and the Cold War began to end – the year economic globalization was born in a shift Thomas Friedman characterized as "dominated by American power, American culture, the American dollar, and the American navy" (Friedman, 2000, p. xix). Advances in the application of mathematics, science and engineering (MSE) technology fueled the rapid growth of economic globalization. In October 2005, a special committee of the U.S. National Academies issued the report, "*Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*" (Barlas, 2006). This report concludes that the U.S. needs "better-trained, more technologically sophisticated workers and engineers" due to "the effects of globalization, which has produced a situation in which 'workers in virtually every sector must now face competitors who live just a mouse click away in Ireland, Finland, China, India, or dozens of other nations whose economies are growing'"(Ibid). In January 2006, President Bush spoke to this concern when he announced his American Competitiveness Initiative (ACI), "a broad package of proposals to increase investments in R&D [Research and Development], strengthen education, and encourage entrepreneurship and innovation" (Bush, 2006). The package includes increased funding and permanent tax credit for critical basic research programs in engineering and physical sciences, training of 70,000 high school teachers in mathematics and science (M&S) high school-level Advanced Placement/International Baccalaureate (AP/IP) programs, and the production of 30,000 M&S professionals as adjunct high school teachers (Ibid). This paper examines the state of the U.S. educational system's to produce a globally competitive, educated and skilled workforce in the fields of MSE, and recommends extra actions to strengthen the ACI.

Analysis Of The State Of U.S. Education In Math, Science, And Engineering

The U.S. education industry begins with three- to four-year-old children attending public pre-schools, such as Head Start, and private pre-schools, and extends through public and private colleges and universities. The education of a child in the U.S. is shaped by the student's environment, school infrastructure, community support, employer demand, and government policies. The child who pursues an educational path leading to a career in MSE is influenced by exposure, experience and encouragement.

Environment. Children in the U.S. come from various socio-economic backgrounds ranging from the very poor to very wealthy. They attend inner city, suburban, and rural schools, private and public. English may be their second language at school and never spoken at home. The student's background influences their performance and can affect their earning of a science, technology, engineering, and mathematics (STEM) discipline degree as demonstrated in Table 1. However it is good preparation given by a rigorous

and challenging high school course of study that is the strongest predictor of college completion with performance in mathematics being the strongest predictor and lab science being the second (Schmidt, 2006 and Sclafani, 2005).

Table 1. Demographics and STEM Education Performance

Education Level	All Students	Hispanic Students	African-American Students	Asian-American Students	White Students	Low Income
2002 Below Basic – 12th Grade Mathematics Assessment[1]	35%	56%	69%	NA	NA	60%
2003 High School Graduate[2]	70%	52%	51%	NA	72%	NA
1995 Enter STEM in College[3]	NA	22.7%	18.6%	24.6%	18%	NA
2nd Year in STEM[4]	NA	12.7%	10.4%	14%	10.3%	NA
6th Year in STEM – Obtained Degree[5]	NA	7.9%	6.5%	13.3%	8.9%	NA

[1] (Sclafani, 2005) [2] Ibid [3] (Schmidt, 2006) [4] Ibid [5] Ibid

School Infrastructure. Its people and its physical assets define the infrastructure of a school with the most important influence on student learning being the quality of the teacher (NSB, 2006). Ingersoll argues, "One of the most important characteristics of a qualified high school teacher is college training in the subject in which he or she teaches" (Ingersoll, 1996). A teacher is considered an out-of-field teacher if the teacher is "teaching one or more mathematics, science, social studies, or English classes without at least an undergraduate or graduate-level major or minor in the particular subject" (Ibid). In 1990, mathematics had the highest percentage of out-of-field teachers with nearly one-third not having a college major or minor in mathematics or mathematics education (Ibid). In science, the percentage was one-fifth. Schools with fewer than 300 students, public and private, had greater percentages than larger schools. Studies have shown that secondary school students of out-of-field teachers tend to have lower achievement than students of certified teachers (Guarino, 2006).

The U.S. Department of Education conducted an examination of the effect of teacher qualification on the achievement of kindergarten students. "A full-day kindergarten structure" was "found to be associated with the relatively large gains in achievement" (Ibid). Overall, teacher qualification affects student performance; however, the supply of qualified teachers does not meet the demand, resulting in school districts hiring less-qualified candidates to fill teaching vacancies across all levels of education (NSB, 2006). This presents a challenge for the education industry and the nation.

Community Support. The Promoting Regional Improvement in Science and Math (PRISM) Project in Central Florida, the Bay Area-based Industry Initiatives for Science and Math Education (IISME), and the PRIME project are all examples of communities

coming together to support and strengthen local educational systems. Each of these programs is in response to sustaining globally competitive communities and all have specific objectives focused on education over many years.

The PRISM Project is a 10-year campaign aimed "to achieve world leadership in" M&S education (Brennan, 2006). The project is co-sponsored by the Orlando Regional Chamber of Commerce and eight school districts in Central Florida (Editorial, 2005). The motivation for the program is the recognition that almost half of the middle school M&S teachers are out-of-field teachers and that universities and colleges produce less than 5% of the new M&S teachers needed annually statewide (PRISM, 2006). The PRISM Project's initial initiatives include recruiting, retaining, and monetarily rewarding high quality M&S teachers, providing teachers access to best practices on effective M&S teaching programs and methods, increasing the number of M&S competitive events for middle school students through grants to cover costs, and establishing for high school students who excel in rigorous M&S classes a prestigious diploma that will be recognized by colleges and universities as qualifying for special admissions considerations (Ibid).

The IISME and the PRIME project have similar initiatives. The IISME, "founded in 1985 by a consortium of San Francisco Bay Area companies in partnership with the Lawrence Hall of Science at the University of California at Berkley," has a mission of transforming teaching and learning committed to enhancing M&S education (Tatum, 2004). "A key IISME initiative is its Summer Fellowship Program that places qualified teachers into local companies for an eight week learning experience" guided by an industry mentor while solving real-world problems (Ibid). The PRIME project "is a collaborative effort involving Illinois State University's Mathematics Education faculty and all 330 K-5 classroom mathematics teachers, their administrators, parents, and community partners in Peoria District 150, the second largest urban school district in Illinois" (PRIME, 2006). The PRIME objectives are focused on improving teachers' mathematical content knowledge, extending teachers' understanding of the pedagogy of the Investigations in Number, Data and Space mathematics curriculum, mentoring teachers' in "reflective analysis of mathematics teaching and learning," fostering teacher leaders and the development of a community of learners, and promoting teachers and families communications (Ibid).

Employer Demand. The nature of the workforce is constantly changing with the "fastest growing jobs requir[ing] some education beyond high school" (Sclafani, 2005). The skill level has changed from 60% unskilled, 20% skilled, and 20% professional in 1950 to 15% unskilled, 65% skilled, and 20% professional in 1997 (Ibid). Both government and non-government employers recognize their responsibility to support the educational systems, as it is the source of their human capital.

As Boeing Chairman and CEO, Phil Condit states, "we also believe that education – education for everyone – is critical to the future of our world" (Condit, 2006). Boeing's education strategy is to align and leverage "all resources to support systemic and continuous improvement in public school systems", focus "on teacher effectiveness in K-12 public education, focus initiatives targeting M&S, and literacy," and "enable all children to succeed in a technological global society" (Condit, 2006). Boeing is involved in the New Leaders for New Schools program in Chicago with ten of its senior leaders mentoring aspiring urban school principals to be effective leaders (Ibid).

Another example of industry education partnerships is the Experiences in Industry program conducted by Mississippi State University, National Science Foundation (NSF), Northrop Grumman, Tennessee Valley Authority, plus over 40 local partners designed to bridge the gap between the classroom and the workplace (Harpole, 2004). The program benefits educators in learning real world applications to supplement their curriculum and by serving as full partners in educational reform efforts by industry and business (Ibid). The program is of value to industry and businesses by sharing with educators the requirements for a competent workforce through workplace experience and by enhancing employee internal relations with contributions to education.

G*overnment Policies.* The No Child Left Behind (NLCB) is potentially both valuable and detrimental in developing an educated citizen. It ties federal financial incentives to increasing the reading and mathematics proficiency of students as measured by annual exams. If the students do not achieve a specified level of proficiency their school is placed on a public list for failing to make adequate yearly progress and is subject to corrective action. The response of several schools systems from Vermont to California is to restrict those low-proficiency students to studying only reading, mathematics and gym with a focus on passing the proficiency tests (Dillon, 2006). There is a substantial risk in teaching to pass the test in that the student will not have the benefit of a well-rounded education that makes him/her a productive member in the global marketplace.

Global Comparison of U.S. Performance in Math, Science, and Engineering

On January 13, 2006, the National Science Board (NSB) submitted its biennial *Science and Engineering Indicators 2006* report presenting details on MSE education at all levels with a focus "on global science and technology [S&T], including international trends and the U.S. position in the global context" (NSB, 2006). The report finds that mathematics performance improved while science performance declined and "in both subjects, only about one-third of 4^{th} and 8^{th} grade students, and even fewer 12^{th} grade students, reached the proficient level" (Ibid). On the 2003 Trends in International Math and Science Study (TIMSS), both U.S. 4^{th} and 8^{th} graders scored above the international average while on the Programme for International Student Assessment (PISA), U.S. 15 year olds scored slightly below the global average (Ibid).

The most likely competitors to the U.S. in the knowledge-based, high technology markets requiring M&S skills are China and India (Ibid). There have been several reports that indicate the U.S. is producing six to ten times fewer engineers a year than China and India (Samuelson, 2006). The Chinese and Indian figures "include graduates with two- or three-year degrees – similar to 'associate degrees' from U.S. community colleges" (Ibid). When similar data are compared, the U.S. per million people "graduates slightly more engineers with four-year degrees than China and three times as many as India" (Ibid).

China. The Chinese "government has declared education and S&T to be the strategic engines of sustainable economic development"(NSB, 2006). China so far does not approach parity in scientific research with major science-producing nations, such as the U.S., however "its scientists are collaborating broadly with their counterparts in Asia and across the globe"(Ibid). China has become the world's third largest R&D performer, "behind only the U.S. and Japan" (Ibid) Among major nations, the U.S. has quickly

developed the most high-technology-intensive manufacturing sector; however, the U.S. has a negative high-technology trade balance that favors the Asian region (Ibid). The science and engineering labor force, as estimated by the number of people with a postsecondary education, indicates the U.S. share, which is the largest, fell from 31% to 27%, China doubled to 10% and India doubled to 8% (Ibid). In 2003, Chinese 4th and 8th graders outperformed U.S. 4th and 8th graders in M&S, respectively (Gonzales, 2004).

India. India is pursuing rapid technological development in knowledge-intensive service sectors and biotechnology (NSB, 2006). India is encountering "an increasingly difficult time finding qualified workers for its booming services sector" (Larkin, 2006). It is estimated that by 2010, they could have a deficit of 50,000 workers. India's future is impeded by an out of date higher-education system that produces about 3 million graduates a year with "uneven quality that many aren't employable" (Ibid). In India, less than 10% of high school graduates pursue higher education, compared to 64% of U.S. graduates (Ibid). India's system of 17,000 colleges and universities has about a dozen "top business and technology schools on a par with the U.S. Ivy League schools" (Ibid).

Recommendation To Strengthen The American Competitiveness Initiative

In addition to President Bush's ACI, it is recommended that two new proposals be considered with focus on community support and employer demand shapers of education. The first is to transform traditional high schools with vocational programs designed for the industrial age into information age high schools (IAHS) with technological application programs. The curricula of these IAHS should incorporate classes where half of the time the students receive hands on training in a technological field and the other half in rigorous academic training, similar to Minuteman Regional High School in Lexington, Massachusetts. This would be accomplished in partnership with local businesses, colleges, and universities that would benefit from the human capital produced. The second is modeled on a combination of the PRISM, PRIME, and IISME. It is proposed that financial and tax incentives be provided for business, universities and colleges, and K-12 school systems to support and promote collaboration for sharing of leadership best practices, communicating the needs of each member and their ability to meet the needs, and addressing the gaps between needs and ability.

Conclusion

The U.S. education industry supplies an educated MSE workforce that maintains the U.S. lead in a very competitive, rapidly growing, interdependent, global marketplace. Its strengths are its openness to new ideas, ambition, an acceptance of skilled immigrants, strong partnerships between schools, universities and businesses, and well-funded venture capitalists (Samuelson, 2006). The year is 2006 - the year the U.S. focuses on strengthening its education in M&S, and promotes advances in the application of STEM – the year economic globalization continues to be dominated by American power, American culture, the American dollar, and the American navy.

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NO CHILD LEFT BEHIND ACT

Introduction

In 2001, President Bush's No Child Left Behind Act of 2001 (NCLB Act) was passed. The new law defines a framework on how to improve the performance of America's elementary and secondary schools while at the same time ensuring that no child is trapped in a failing school (ED.gov, 2005, p. 1). In particular, the Act is aimed at closing the education gap between white and minority students (NY Times Editorial, 2005).

Discussion

The NCLB Act has five key points that define its charter to improve overall education and ensure each child has the chance to progress. These points are increased accountability for school performance, more choices for parents and students to leave failing schools, greater flexibility for schools to use federal funding where needed, putting reading first and improved teacher quality (ED.gov, 2005). Each of these key points has important characteristics. The NCLB Act requires each state to develop their own challenging standards in reading, language arts, science and math. States must then develop accountability systems to test students in grades 3-8, and develop annual statewide progress objectives ensuring that all groups of students reach proficiency in these standards within 12 years of attending public school (ED.gov, 2005, p. 2). The NCLB Act significantly increases the choices available to the parents of students attending schools that fail to meet state standards. Local education associations must give students attending schools identified for improvement, corrective action, or restructuring the opportunity to attend a better public school, which may include a public charter school, within the school district. The district must provide transportation to the new school (Ed.gov, 2005, p. 2). The NCLB Act gives states and school districts a great degree of flexibility in the use of federal education funds in exchange for strong accountability for results. States are permitted to transfer up to 50 percent of the federal education funding they receive to separate programs that include Teacher Quality State Grants, Educational Technology, Innovative Programs, and Safe and Drug-Free Schools (ED.Gov, 2006). The NCLB Act also carries with it a commitment to ensure that every child can read by the end of the third grade. To accomplish this goal, the Act increases federal funding for scientifically based reading programs for early ages. The NCLB Act provides nearly $3 billion a year to States to ensure teacher quality. This funding can be used to prepare, train, and recruit highly qualified teachers and administrators. The Act requires that teachers in all public elementary and secondary schools be "highly qualified." "Highly qualified" is defined by three criteria. The first is that all teachers must have obtained a full state certification as a teacher and passed the state license exam without any of the license requirements being waved. The second criteria is each teacher, at a minimum, hold a bachelor's degree. The final criteria is for each teacher to demonstrate subject matter competency in each of the academic subjects in which the teacher instructs, in a manner determined by the state and in compliance with the

Elementary and Secondary Education Act (NCLB Annual Report to Congress, 2005, p. 19).

The NCLB Act has many elements that can be hailed as positive, but significant challenges remain. From a positive perspective, every state has put into place new accountability plans outlining how they would achieve the goals of the NCLB Act (ibid, p. 10). NCLB focuses attention on traditionally under-served student groups and tasks schools to use "scientifically based research" practices in the classroom. NCLB has a strong Early Reading First initiative and measures overall student performance in grades 3-8. Parents are provided school performance information and are provided avenues to get their children out of failing schools. In addition, there are now specific criteria that states must meet for each teacher to be considered "highly qualified."

While these are all laudable achievements, there are serious issues with the NCLB Act as well. The first serious issue with NCLB is the fact that school systems and states are punished if they do not meet the performance goals they establish. This reality can push schools to set unrealistically low standards. This approach of allowing each state to determine their own standards and tests appears to be a significant area of concern. The chart below depicts three states, chosen at random, and the discrepancies reported between state and national testing results. The scores are broken out by overall state performance, white, black and Hispanic students. The first percentage score in each cell is the state reported percentage of students scoring at proficiency or higher on state tests. The second score in each cell depicts the percent of students scoring at proficiency or better on federal tests administered in 2005 by the National Center for Educational Statistics through the National Assessment of Education Programs Evaluation.

State	4th Grade Reading	4th Grade Math	8th Grade Reading	8th Grade Math
California				
Overall	39% - 22%	46% - 28%	31% - 21%	29% - 22%
White	59% - 37%	61% - 46%	42% - 34%	42% - 34%
Black	27% - 10%	29% - 13%	17% - 11%	12% - 7%
Hispanic	24% - 10%	33% - 14%	16% - 10%	15% - 9%
North Dakota				
Overall	74% - 35%	58% - 41%	69% - 37%	44% - 35%
White	77% - 40%	61% - 43%	72% - 38%	47% - 37%
Black	67% - ND	40% - ND	58% - ND	23% - ND
Hispanic	56% - ND	42% - ND	58% - ND	26% - ND
Alabama				
Overall	63% - 30%	64% - 21%	59% - 22%	56% - 15%
White	76% - 32%	74% - 31%	71% - 31%	67% - 23%
Black	45% - 8%	49% - 6%	38% - 8%	38% - 8%
Hispanic	49% - ND	52% - ND	38% - ND	42% - ND

ND = No Data

An analysis of the percentages in the chart above confirm the troubling reality that state standards and the testing against these standards is not matching up with the sanity check evaluations the federal government conducts at the 4th and 8th grade levels. A second major criticism of the NCLB Act is funding. Many organizations have criticized the federal government for not fully funding the Act. Utah and Connecticut are leading about a dozen states protesting that the NCLB Act imposes costly state obligations without the funding to carry them out (Source Watch, 2005, p. 1). "The Utah House voted 64-8 recently not to comply with any provisions for which the federal government has not supplied enough money (Ibid). A final criticism is in the restrictive definition of teacher qualifications. Some educators argue that the mandate on teacher quality in the Act which focused almost solely on subject matter expertise makes it very difficult to hire teachers in many rural areas where schools need teachers to teach in multiple subject areas (Meier, Kohn, Darling-Hammond, Seizer, Wood, p. 11).

Recommendations

While some aspects of the NCLB Act have been a success, the real issue, and unanswered question, appears to be are students actually improving? The NCLB Act directs states to develop their own performance standards and then conduct their own evaluation. States are then required to report this information to Congress. Failure to demonstrate acceptable student proficiency levels results in a loss of federal funding as a punishment. This logic seems fatally flawed. When a state's federal education funding is tied to goals the state develops and evaluates, there is no motivation to push for excellence. The apparent path that states are taking is to instead set easily attainable, low performance goals to ensure the state continues to get federal funding. In order to correct this basic flaw, the federal government should establish basic performance standards that all states must teach and test against. This basic form can simply be the standards and test methodology currently employed by the National Assessment of Educational Progress test. Another recommendation that is closely tied to the use of standardized assessments in support of NCLB is growth assessment models to measure student performance. These models are geared towards tracking individual student progress on an annual basis instead of, for example, comparing last year's fourth grade class to this year's fourth grade class against a target goal as currently stipulated under NCLB's Annual Yearly Progress (AYP) requirement. Many people view this as a big improvement because it eliminates variability in year groups that can cause inaccuracies in the data (Goldstein and Behuniak, 2005). It appears that Department of Education is attempting to address this issue as they recently announced a pilot program for the development of growth models (up to 10 state models for 2006) that still comply with NCLB's 2014 on-grade requirement for all students.

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TEACHER PROFESSIONAL DEVELOPMENT

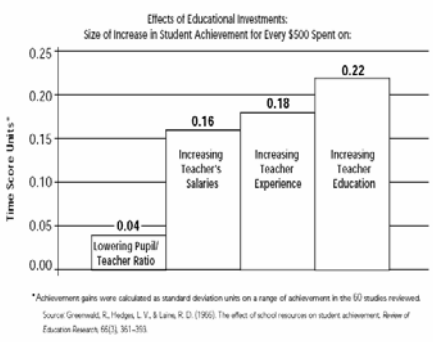
Many experts agree that the single most important factor to educational success is teacher quality. Recent studies in the Boston, Dallas and Tennessee school systems indicate that effective teachers significantly improve grade-level knowledge of their students while ineffective teachers had the opposite effect. For example, over a three year period, Dallas elementary students under the instruction of effective teachers raised their reading scores 76% while those with ineffective teachers decreased their scores by 40% (Haycock, 1998).

The importance of teachers makes America's teacher retention problem even more alarming than it seems at first glance. Today, 46% of new teachers leave this intrinsically rewarding profession in their first five years on the job (Gerstner, 2006). Many place blame for this phenomenon on poor teacher pay or poor teacher preparation programs at colleges and universities (Bowsher, 2001). A respected George Washington University Graduate School of Education professor recently argued that the true cause of poor teacher retention has as much to do with teacher in-service training and professional development as it does lagging salaries (personal communication, April 21, 2006). Additionally, a US Department of Education survey indicated that 40% of teachers departing the profession in 2000 stated that professional development was an important element of their dissatisfaction (U.S. Department of Education, 2005a).

Support and mentorship of new teachers is incredibly important through the first several years in the profession. Unfortunately, teacher professional development is often overlooked. Rachel (as cited in Alliance for Excellent Education), a new middle school teacher in New England, relayed her experience of poor induction support. She reported that her school did not even provide an orientation but handed her keys to a classroom and left her to sink or swim. While she was flattered to be treated like a veteran teacher, she now hesitates to ask questions in fear of showing ignorance. This type of treatment contributes to teacher attrition, especially in challenging schools. New teachers often feel overwhelmed by their workload, isolated from veteran teachers, and unsupported by parents and their school administration (Massachusetts Teachers Association, 2006).

Although an often overlooked feature of the legislation, NCLB acknowledges the importance of continuing professional development. It includes provisions for implementing on-going training to enhance teacher understanding of the latest scientifically based techniques that improve student academic achievement (Christy, 2005). Districts that receive Title I funding must expend 5% of their funding on professional development, and districts that fail to meet annual yearly progress for two consecutive years must increase their professional development expenditures to 10% (U.S. Department of Education, 2005b).

Many schools, especially high performing schools, seem confident enough in their performance that they do not take a comprehensive approach to professional development. In-service training often exists as little more than faculty members attending the minimum number of courses required to earn recertification. As the adjacent graph shows, money spent on continuing education derives the more return on investment than many more popular initiatives (McRobbie, 2000).



All but the most naturally gifted teachers need a robust and on-going professional development program to enhance their personal experience and to optimize the positive impact that they make in the classroom. Factors, such as increasing student body diversity, continuously evolving content, new uses for technology in the classroom, and new pedagogy make continuous professional development a necessity (Moss, Glenn, & Schwab, 2005). School officials spend great effort choosing the perfect curriculum for their schools, but implementation plans are often left as an afterthought. A high ranking official at Harvard's Graduate School of Education's Programs in Professional Education stated that despite the best intentions of school officials, new curricula routinely fall short of full implementation due to incomplete professional development efforts (personal communication, April 18, 2006).

Much of the challenge lies in the fact that teachers grow less and less flexible in their perspectives and routines during ensuing years of engaging in what has traditionally been a solitary profession. According to Moss, Glenn, and Schwab (2005), teachers develop their teaching style by merging their own philosophies on teaching and learning with the requirements of their specific school. Altering these styles becomes increasingly difficult as the years pass. However, teaching styles are easier to change when they are engaged professionally, must interact with peers, and work in a collaborative setting from the beginning of their career. (Becker and Riel as cited in Moss, et al., 2005). The key then to best practices in professional development is in fostering a comprehensive and on-going learning environment.

The teaching profession presents an interesting paradox. While the public often cites the importance of teachers, there has been no nationally accepted standard for initial or in-service teacher training. When teachers make such an enduring impact on our nation's children, should they not receive rigorous training like that required in many other professions such as the medical and aviation fields? Both doctors and pilots enter an apprenticeship following medical or flight school graduations. More experienced colleagues supervise, evaluate, and mentor them during the first several years of their work life. Both mentor and protégé benefit from the professional relationship.

Experts in the teacher professional development field agree that these professions provide a good example for educators. A recent study argues convincingly that school workers must be just as structured in their learning as the students (Sparks & Hirsh, 2006). As more data supports the correlation between improvements in teacher knowledge and rising student performance, one could argue that the clear path to enriching the American public education system lies in creating, funding, and implementing staff development plans for both instructors and administrators.

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