EDUCATION

ABSTRACT: The education industry is critical to US national security and economic well-being. Our assessment of the industry produced mixed results with positives in educational opportunities and numbers of students attending college, and negatives in comparative international test results, gaps in minority student achievement, and rising costs. Significant opportunities and challenges still exist, especially in the areas of teacher certification, recruitment, retention; evolving "No Child Left Behind" legislation; math, science, engineering achievement; accommodation of shifts in demographics and equal access to quality education; and preparing our education system to meet the changing demands of a growing global economy through collaborative efforts.

Lt Col Badar Al Baram, Oman
LTC Donna Alberto, USA
LTC John Collins, USA
Ms. Theresa M. Conte, Marine Corps
CDR Scott Dueker, USN
CDR John Funk, USN
CDR James Hopkins, USN
Lt Col Cory Lyman, ANG
LTC Jeffrey Mello, USA
Lt Col Michelle C. Miller Peck, USAF
Mr. Joseph Riehl, Dept. of Justice
Ms. Dorothy Rudik, Dept. of the Army
Lt Col Norman Schaefer, USAF
Capt Tan Eng Seng, Royal Malaysian Navy, Malaysia
Lt Col Roger Vincent, USAF
Lt Col Louis Zuccarello, USAF

Dr. Francis A'Hearn, faculty
Professor William Mayall, faculty
COL Mark McGuire, USA, faculty

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
2005	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Education	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **The Industrial College of the Armed Forces National Defense University Fort McNair Washigton, DC 20319-5062**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**SAR**	**34**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

PLACES VISITED:

Domestic:

US Department of Education, Washington, DC
US House of Representatives, Washington, DC
Maryland State Department of Education, Baltimore, MD
Montgomery County Schools, Rockville, MD
Potomac Job Corps Center, Washington, DC
Thomas Jefferson High School, Alexandria, VA
Mountain View School, Centreville, VA
Focus Hope, Detroit, MI
General Motors University, Detroit, MI
Boston Latin School, Boston, MA
Harvard University, Boston, MA
Minuteman Science-Technology High School, Lexington, MA
Chelsea School, Chelsea, MA
Northern Essex Community College, Haverhill, MA
Boston Renaissance Charter School, Boston, MA
Houghton Mifflin, Boston, MA
Raytheon Corporation, Waltham, MA
American Federation of Teachers, Washington, DC
Educational Testing Service, Princeton, NJ
Association of American Publishers
Council of Great City Schools, Washington, DC
World Bank, Washington, DC
Home School Legal Defense Association, Purcellville, VA
Department of Defense Education Activity, Arlington, VA
Congressional Sub-Committee on Education and the Workforce, Washington, DC

International:

Department for Education and Skills, London, England
Teacher Training Agency, London, England
Qualifications and Curriculum Authority, London, England
The British Museum, London, England
Tiffin Girls' School, Surrey, England
Enfield County School, Enfield, England
Heidelberg High School, Heidelberg, Germany
Baden-Wurttemberg Schools, Stuttgart, Germany
Deutsche Bank, Frankfurt, Germany
Goethe Gymnasium, Frankfurt, Germany

INTRODUCTION:

Education is a cornerstone industry that impacts all other industries and directly impacts our national security. Well-educated and skilled citizens are our most important assets because they are essential to the United States maintaining its global competitive advantage, strong economy, and critical national security.

The purpose of this study was to conduct a broad assessment of the US education industry as it relates to our future national security and competitive advantage in the global economy. Our methodology was to use tours and discussions with subject matter experts from various domains (foreign and domestic), lectures, and literature searches to identify findings, deduce conclusions, and make policy recommendations. The paper is structured by defining the education industry, assessing its current condition, analyzing its challenges and outlook for the future, examining the government's goals and roles, making policy recommendations toward improvement, and providing the results of individual research on selected industry topics. As an adjunct to the study, selected individuals examined the e-textbook industry for the Department of Defense Education Activity (DODEA).

THE INDUSTRY DEFINED:

Is education actually an industry? If we define an industry as an organization, or series of organizations, whose purpose is to employ a process to produce a viable product of some measurable cost and benefit to society, then education meets this definition. More precisely, "education is to the state and local governments what defense is to the federal government. Military organizations are a business and are managed like a business, except that they have no profit objectives. Schools are exactly the same."[1]

Education in America consists of many public and private organizations (traditional academic, transitional, and workplace) employing various teaching/learning techniques to produce an educated citizenry and competent workforce to sustain our national security and global economic advantage. However, obtaining the benefits of education does not come without considerable costs to its many constituents (students, parents, teachers, community, corporations, and government) in the form of public and private funds, opportunity costs, and externality costs.

The simplest way to define the education industry is by type and size. By type, it breaks down into the three broad categories of traditional academic institutions, transitional non-academic institutions, and corporate education and training institutions. By size, it's defined in terms of distribution of funds, facilities, and populations by sector (public vs. private).

Traditional academic institutions consist of primary, secondary, and post-secondary schools (aka K-12 and higher education institutions) including standard, charter, and magnet schools, as well as junior/ community colleges and four-year universities. Their primary focus is on academic/ college-prep work for professional careers. Transitional institutions are made up of vocational/technical schools, "school-to-work," apprenticeship, and job training programs designed to teach trades for a skilled labor workforce. Corporate training and education institutions are usually contained within

individual companies with specifically designed programs for every level of employees, from assembly-line workers to middle managers to senior executives.

The current size of the education industry is formidable. In 2001, all public primary, secondary, and post-secondary education consumed $780 billion or 7.7% of the GDP, and of that amount, public K-12 education was $463 billion, or 4.6% of the GDP.[2] "If all of the government budgets (federal, state, and local) were consolidated into a single package, the second largest taxpayer expense would be the public school system, which costs far more than the entire defense budget, or the interest on the national debt, or Medicare."[3] In 2001-02, there were 98,000 public schools of all levels (94K elementary and secondary; 4K post-secondary), while private post-secondary schools numbered only 7,000 (elementary and secondary numbers unavailable).[4] Projected total enrollment in educational institutions at all levels for 2004 was 71 million students (61M in public schools vs. 10M in private; 48M in public K-12 vs. 6M in private; 13M in public post-secondary vs. 4M in private), with only 3.4 million teachers in the K-12 category (3M public vs. 0.4M private).[5]

This industry is too large and varied to cover adequately within the scope of this study, so the focus of this paper is on traditional academic primary and secondary (K-12) public education. As the largest category by all measures, with the most problems and most governmental influence, successful K-12 public education is the key to our security.

CURRENT CONDITION:

The current condition of education in the United States is a mixed picture. Multiple agencies and organizations with a stake in the US education system have studied its effectiveness and produced many valid concerns about the current state of education in America. Research by the Gates Foundation suggests that only two in three ninth graders will ultimately be awarded a high school diploma.[6] Their data for Black and Hispanic students indicate that only about 50 percent in these racial groups earn a diploma and fewer than 20 percent who graduate are adequately prepared for college.[7]

In November 2004, Representative John Boehner made remarks prior to the Congressional hearing on "Transforming the Federal Role in Education For The 21st Century". He stated "Nearly 70 percent of inner city and rural fourth graders cannot read at the basic level; low income students lag behind their counterparts by an average of 20 percentile points on national assessment tests, and one-third of all incoming college freshmen enroll in a remedial reading, writing, or mathematics class."[8] In January 2005, Secretary of Education, Margaret Spellings indicated that "40 percent of students entering four-year colleges and universities require some remedial education."[9] Given statistics such as these, concerns for the US education system are warranted.

International comparisons generate other concerns about America's education system. The Organization for Economic Cooperation and Development (OECD), comprised of 30 industrialized nations, conducts assessments of students internationally and reported the following data from testing 15 year old students in 2003.

> "U.S. performance in mathematics literacy and problem-solving was lower than the average for OECD countries. U.S. scores were roughly the same as they were in 2000, whereas some other countries improved their

> performance and moved ahead of the United States in the rankings. Roughly two-thirds of OECD countries [or 20 nations] outperformed the United States. The United States had more students at the lowest levels of performance and fewer students at the highest levels than the OECD average percentages."[10]

While there are critics of the methods used to assess student learning from country to country, the findings nevertheless generate important discussions about the competitiveness and preparedness of US students compared to their international peers.[11] On a positive note, in 1999, 28 percent of adults, ages 18 to 24, in the United States were enrolled full time or part time in higher education, which topped Canada, the United Kingdom, Italy, and Germany.[12]

In spite of concerns in the literature, there are a number of organizations and individuals who are optimistic about the current status of the US education system. US investment in education, for instance, has been considerable. From 1990 to 2001, expenditures on public education nearly doubled (from approximately 208 to 400 billion in annual funding).[13] One study indicated that the number of Americans with a high school degree increased from 52 percent in 1970 to 85 percent in 2003.[14] During the same period, from 1970 to 2003, those with a college degree jumped from 11 to 27 percent.[15] The number of "status drop-outs" (defined as individuals aged 16-24 years old who are not enrolled in school and who have not completed a high school program) steadily declined from 15% in 1970 to 10.7% in 2001.[16] Data from the National Center for Education Statistics show that the number of actual high school drop outs in 2000-2001 was approximately 4.6 percent.[17] Meanwhile, the number of students nationally who "left high school with the skills and qualifications necessary to attend college increased from 25% in 1991 to 34% in 2002."[18] These data show positive trends in educating America's youth.

Much of what is working well in the US education system was summarized by J. E. Bowsher who observed, "Students are taking more challenging courses. The number of students taking Advanced Placement examinations has increased dramatically, and the drop-out rate has been reduced. The United States leads the world in the number of college-age students who attend institutions of higher education. About 25 percent receive a college degree, which is also higher than most countries."[19]

Two areas of the education system require special focus. These include: 1) the wellness of urban and inner city schools, and 2) the overall efficacy of the US education system when viewed demographically. To address the first concern, 65 of the Nation's largest urban public school systems have formed a coalition called The Council of Great City Schools. Their March 2003 report indicated clear progress in the area of mathematics and reading. The report states that approximately "86.5% of all grades tested in the Great City Schools showed gains in math scores. Some 43.9% of all grades tested in the Great City Schools improved their math scores faster than other schools in their states."[20] In reading, "Approximately 71.5% of all grades tested in the Great City Schools showed gains in reading scores. Some 46.7% of all grades tested in the Great City Schools improved their reading scores faster than their states." This said, the report notes that "Trend lines are not the same from one city to another. Not all grades have improved at the same rates. Not all gaps are closing. But the data indicate progress."[21]

The second topic of special concern is demographics. The education gap between races in America is significant. The Manhattan Institute for Policy Research reported that there is a wide disparity in the graduation rates of white and minority students. "In the class of 2002, about 78% of white students graduated from high school with a regular diploma, compared to 56% of African-American students and 52% of Hispanic students. There is also a large difference among racial and ethnic groups in the percentage of students who leave high school eligible for college admission. About 40% of white students, 23% of African-American students, and 20% of Hispanic students who started public high school graduated college-ready in 2002."[22]

The amount of research and energy that is being dedicated to identify and resolve education problems is heartening; the direction of US education is generally encouraging. The charge to US policymakers and educators is to remain engaged and to support efforts toward the progress and improvement of education. The Nation's combined efforts to improve education will yield far-reaching benefits if successful. By the same token, failure will result in detrimental societal consequences.

CHALLENGES:

The education industry currently faces significant challenges. These challenges include teacher recruiting and retention, teacher quality and certification, a shortage of math and science degree majors/graduates and successful implementation of the "No Child Left Behind" Act. Chief among these challenges is solving the shortage of qualified teachers in America's classrooms. In fact, "…nearly 25 percent of new teachers leave the vocation within two years, and 40 percent of new teachers leave within five years."[23] The qualified teacher shortage is widely recognized. In the forthcoming decade, estimates place the teacher shortage at 2.2 million.[24]

In addition to sufficient numbers of teachers, quality teachers are required to provide effective education to our youth. School reform efforts must focus on improving teacher quality in concert with increasing overall teacher numbers.

> Unfortunately in order to meet these new demands, many states have lowered standards and hired teachers with marginal qualification. More than 30 percent of newly hired teachers lack full certification when they enter the profession, more than 11 percent enter the classroom without a license, and more than one-quarter of public school teachers are teaching subjects out of their field.[25]

To compound these issues, the United States is experiencing a significant shortage of qualified teachers particularly in the areas of math, science, and technology. These critical teacher demand areas currently do not compete well with other available job opportunities in these specialties, especially with respect to salary. This in turn negatively impacts the quality and quantity of math and science graduates that our nation produces. Focusing specific emphasis on math, science, and technology Newt Gingrich, former Speaker of the US House of Representatives, points to the Hart-Rudman

Commission findings "that the second greatest threat to American national security is the failure of math and science education…What makes the Hart-Rudman Commission warning about math and science education particularly ominous is that it came eighteen years after the Reagan administration published *A Nation at Risk*."[26]

Effective implementation of the No Child Left Behind (NCLB) Act poses another challenge for the US education industry. Issues contributing to the NCLB implementation challenge are effective testing, state set performance standards, and funding. The major goal of NCLB is that all children will be proficient in reading and math by 2014. In order to measure progress towards achieving this goal, the NCLB Act requires annual testing of students in reading and math in grades three through eight. Unfortunately, 70 percent of year-to-year changes in test scores for all grade levels are due to random variation. Differences in the student body from year-to-year, combined with statistical errors in the tests themselves make it impossible to know if the students are making real gains (or losses) or whether the changes are merely random noise.[27]

The second challenge to implementation of NCLB is that standards and curriculum are set by each state. There is concern that NCLB will force schools to teach to the tests and states will narrow their curriculum to focus on reading, math, and science. In states where there seems to be an increase in students meeting the standards, there does not seem to be a correlating increase in high school completion or college attendance. A study of the Texas school system found that as scores on the Texas Assessment of Academic Skills improved, dropout rates increased. It is inferred from this study that, as the poorer performing students drop out, the ratio of high performing students to poor performing students increases, making it easier to meet the standards.[28]

Opponents believe that NCLB is increasing the cost of elementary and secondary public education without providing adequate Federal funds to pay for these requirements. They contend that under NCLB, the current administration has "left behind 4.6 million children by failing to provide adequate resources for the Title I program…" to the sum of $26 billion.[29] Supporters counter that there is sufficient funding. They cite two different studies; one by Accountability Works (a non-profit organization), and the other by the General Accountability Office (GAO). The Accountability Works study identifies that, according to the Department of Education (DOE), states have returned $124 million of elementary and secondary funds to the federal government and another $2.1 billion has not been spent. In addition, the DOE also shows that, as of the beginning of 2004, $1.9 billion of Title I funding over the last four years has also not been spent. The GAO study calculated projected costs for increased testing requirements. They found that, based upon their calculations, appropriated funding to date is well within the cost range anticipated.[30]

OUTLOOK:

The US education industry must develop solutions to the challenges outlined above if it is to meet the Nation's future national security needs. If the US education industry fails to take the necessary actions to implement and adapt NCLB standards and initiatives, recruit and retain a highly qualified teacher workforce, and develop and increase production of domestic science and engineering graduates, the industry's ability to satisfy future national security resource requirements will not be sufficient.

The short term (2005-2010) outlook for the education industry is promising. NCLB legislation, combined with a renewed awareness of the importance of improving education in light of global competitiveness, has created an environment conducive to addressing education challenges. There is popular demand for higher standards and improvement in student performance. Ninety-one percent of Americans support requiring schools to set and meet annual academic progress goals, requiring states to have highly qualified teachers in every classroom, and requiring schools to give parents an annual progress report on academic achievement.[31] Both the President and Congress have acknowledged the qualified teacher shortage and are attempting to address it through a variety of initiatives under the "Quality Teacher In Every Classroom" provisions of NCLB. Educators at the state and local level are recognizing the need for increased salaries, greater administrative support, and teacher mentoring programs as a means to recruit and retain teachers. According to a recent American Collegiate Testing report, the continued decline in the number of US citizens enrolling in science and engineering programs is likely to continue in the short term.[32] However, new initiatives from both government and private industry intended to spark interest in science, math, and technology combined with efforts to recruit highly qualified science and math teachers are proving critical to addressing this problem.

The long term outlook for education is far more uncertain. The US economy will continue to demand a more educated, technically-oriented workforce to remain a world leader. Technology will continue to increase in importance, placing workforce demands on all sectors of the education industry. The lack of qualified teachers looms as one of the biggest long term challenges facing the education industry. The Hart-Rudman Commission estimates that the US will require as many as 2.2 million new teachers in the next decade, with more than 240,000 of those positions being newly qualified math and science teachers.[33] The world's premier science and engineering workforce will continue to shrink due to retirements, reductions in foreign-born graduates who remain in the US, and decreasing numbers of US-born science and engineering graduates.

Changing demographics will place additional stress on the industry. The continued increases in immigration and fertility rates of minorities will require renewed efforts to successfully meet the educational needs of this growing part of the US population in the decades ahead.[34] In addition, US industry will play a much larger role in education by sponsoring and funding initiatives for elementary through higher education systems to further develop the workforce required to maintain its standing in the global marketplace.

Demographic trends in the US signal a shrinking white majority while the Hispanic population is quickly expanding. By the year 2050, America's Hispanic population will increase from its present 13 percent to 24 percent. The Black and Asian populations, which made up nearly 17 percent of the US population in 2000, is also growing. According to Census Bureau projections these groups will grow to 22 percent of the population by 2050.[35] Put another way, the white population, which in 2000 made up about 70 percent of the population, will comprise only 50 percent of the US population by the year 2050. If the education gap described above is not corrected, the resulting mismatch between demographic growth and academic performance could have staggering social and economic consequences.

There are a variety of political and social factors that will impact the education industry's short and long term outlooks. The continued push for standards-based

educational reform and associated funding through the NCLB legislation will continue to be the primary political issue in the short term. Education Secretary Margaret Spellings has stated her commitment to enforce NCLB legislation with greater flexibility in the years ahead. Despite this added flexibility, the Utah legislature has passed legislation declaring that state laws be given priority over federal provisions. The National Education Association, the nation's largest teacher's union, has filed a lawsuit charging the federal government with providing too little funding.[36] The ability of the administration and Congress to address these legal challenges will determine the success of standards-based reform. Within the Congress, debate will continue to focus on the adequacy of funding for NCLB. As previously noted, critics have already claimed that the President and Congress have "left behind 4.6 million children by failing to provide enough resources" to the sum of $26 billion.[37] However, if properly implemented with flexibility and adaptability, NCLB will improve performance over the long term. In addition, action is required to recruit and retain qualified teachers. Improved compensation, effective mentoring programs, and administrative and professional support are critical to meeting future workforce requirements. The industry must intensify efforts to develop a robust science and engineering pipeline to replace significant losses in the workforce. Generating student interest in science and engineering during all phases of elementary and secondary education, increasing minority participation and achievement, and recruiting and retaining a highly qualified math and science teaching corps, are essential elements to maintaining US prowess in science and engineering.

Changing demographics will fundamentally change the scope of efforts required to successfully educate the US population as a whole. All sectors of the education industry must play a role in meeting this challenge. Alternative elementary and secondary schools, community colleges, corporate education and job training programs must recognize the needs of a very diverse population and produce a workforce that satisfies growing demands at a variety of skill levels. Private industry must make investments in education that promote creation of a technically proficient labor force that excels within an increasingly competitive global marketplace. As the US Commission on National Security for the 21st Century warns, if the nation does not take action now "…complacency with our current achievement of national wealth and international power will put all of this at risk."[38]

GOVERNMENT GOALS AND ROLE:

Each level of government (Federal, state, and local) has a role in education, but state and local governments play the largest role. For Academic Year 2002-2003, government funding for elementary and secondary schooling was as follows:[39]

	Spending (billions)	Percent
Federal	39.2	8.1
State	221.7	46.0
Local	178.3	37.0
Other*	42.8	8.9
Total	482.0	

*Other is comprised of private funding.

The relatively small Federal role is derived from the US Constitution's Tenth Amendment: "The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people."[40] Because the Constitution does not discuss education, the states have historically taken the dominant role. This is appropriate, because state and local control of education allows each locality to meet any unique educational needs and allows for regional differences in educational content and delivery. Although the United States education system is primarily funded and run at the state and local levels, the Federal Government does have a role. Because an educated population is vital to national security and prosperity, the Federal government has a vested interest in ensuring that state and local governments are adequately educating their students. The Federal Government exercises its oversight in three ways: requiring states to establish standards and measure student performance, comparing educational performance between States, and funding various educational programs.

The No Child Left Behind (NCLB) Act requires states to establish student performance standards and then measure them to ensure each student is learning at the expected level. This will identify poorly performing students and schools, allowing the state and local governments to provide assistance. Although NCLB requires the states to set student performance standards, there is a risk that some states will set exceptionally low standards and then claim educational success. By comparing student performance between states, the Federal government identifies relatively poorly performing states. This creates public pressure for states to improve. The Federal government does this via the National Assessment of Educational Progress (NAEP), a nationally representative and continuing assessment of student performance in various subject areas. NAEP does not provide scores for individuals or schools, but offers results regarding subject-matter achievement, instructional experiences, and school environment for populations of students and subgroups of those populations. NAEP reports information for the nation, geographical regions, and the states. It includes students drawn from both public and nonpublic schools, and reports results for student achievement at grades 4, 8, and 12.[41]

Federal funding grants include: Title I - Improving the Academic Achievement of the Disadvantaged, Title II - Improving Teacher Quality and Educational Technology, Title III - English Language Acquisition Program, Title IV - Safe and Drug-Free Schools, and Title V - Innovative Programs.[42] Although the amount of Federal funding is relatively small, it serves to encourage the states to implement NCLB and participate in NAEP. States have the option of refusing to establish and measure student performance standards, but then they lose Federal funding. This option serves as an incentive for the states to comply with the Federal government educational goals and objectives under the NCLB Act. The Federal government must continue to remain involved in education. Although state and local governments will remain dominant, only the Federal government can address issues of national interest. For example, the shortage of college students pursuing math, science and engineering degrees is a national security issue. Therefore it is a Federal concern, not simply a state concern. Possible Federal solutions include college loan grants to math and science students and encouraging the states to do a better job teaching math and science in (K-12). This goal could be met by financially rewarding states that raise math and science standards or provide higher pay for math and science teachers.

The state role in education is to establish standards and measure student performance, measure school and school district performance, provide general curriculum guidance to local governments, establish teacher qualifications, and establish funding distribution between school districts. One area where states could drive improvement in education is teacher certification. Certification should be portable between states. Today, when teachers move, they must recertify in each state. This requirement takes time and limits the supply of teachers. While a required Federal certification would probably be resisted by the states, each state can identify other states from which it is willing to accept teacher certifications as many do now. It is possible that NCLB requirements for highly qualified teachers will result in a convergence of state teaching certification standards which would facilitate reciprocal certification agreements between states.

Some states have expressed dissatisfaction with NCLB, due mainly to the requirement to measure student performance. Recently, eight school districts in Michigan, Texas, and Vermont have joined with the National Education Association to sue the US DOE over NCLB. States feel NCLB is an unfunded mandate, pointing to the cost of administering and preparing students for the tests.[43] States are spending funds to teach their students to meet standards that have been established by the states. But educating students is the job of the states, not the Federal government. Asserting that NCLB is an unwarranted federal mandate, Utah recently passed a law ordering state officials to ignore provisions of NCLB that conflict with Utah's education goals or that require state financing.[44] According to the DOE, "There is no federal mandate except this: NCLB asks that children read and do math at grade level, and all students have opportunities for success. This is the goal of public education."[45]

Local government's role in education will remain as the primary service deliverer. The local level establishes detailed curricula, hires and fires teachers, runs the school systems, interfaces with students and parents, and educates students. The recent emphasis on measuring student and school performance will only help the local level to better identify students, schools and teachers that need additional assistance.

While the US education system is managed primarily at the state and local levels, both the British and German systems are much more centralized with significant national control. In Great Britain, students are taught using a single, national curriculum, resulting in minimal disruption to students who change school districts. In Germany, students are tested after completing their fourth year of education and are then placed into one of three different education tracks, depending on their test scores. Neither of these approaches to education is feasible in the United States because education is primarily a state and local concern.

There are, however, areas of education in England that merit consideration. One area is the Teacher Training Agency (TTA). The TTA takes an active role in all aspects of training England's teachers. The TTA works with colleges to develop a standardized education curriculum, monitors teachers during their first year on the job, and provides access to standardized curricula and lesson plans for every subject taught in Britain's public schools. While following the English model would clearly cross states' rights in America, DOE could create a web-based, central data bank of standardized lesson plans, providing teachers with a starting point from which to build. DOE could also create an incentive for teachers to gain national certification by offering a federally funded bonus for teachers who complete certification. Finally, DOE could offer an additional incentive

to those nationally certified teachers who are willing to mentor teachers who are either new to the profession or struggling in the classroom.

The current division of responsibility in the US between the Federal, state and local governments is appropriate. Despite some state and local government complaints, the Federal government needs to continue to insist that states establish student performance standards and then measure student performance against those standards. It is only through rigorous education quality assurance methods that the Nation can ensure its children are adequately educated.

CONCLUSION:

The ability of our education industry to provide a qualitatively superior workforce directly impacts our nation's industrial base, economy, and national security. Through the implementation of the following policy recommendations, the major challenges can be overcome and the industry can produce the type of people needed to maintain national security and global economic competitiveness.

First, the federal government needs to be flexible and adaptive in working with state and local authorities in implementing NCLB. Many states have expressed dissatisfaction with NCLB for reasons including inadequate funding for implementation, disregard for states' efforts before NCLB, and the methodology for measuring progress in student performance. The DOE should be flexible enough to provide full funding to states that can demonstrate that they are meeting the intent of NCLB provisions in terms of raising student achievement through standards and accountability.

Second, provide financial incentives for pursuing the teaching profession. The federal government should enact legislation that provides financial incentives for college graduates and other professionals entering the teaching profession.

Third, the federal government should provide funding to states and local school systems to establish mentorship programs for new teachers. One of the reasons young teachers leave the teaching profession is that they lack the support and guidance they need as new teachers. States should establish mentorship programs that pay experienced teachers to serve as mentors to new teachers.

Last, the entire education industry led by the Federal government needs to launch a national campaign to address the emerging crisis in the science and engineering workforce. This effort must be led by the President who should direct DOE to work with states, science foundations, and the corporate sector to develop a national plan for attracting more students into the science and engineering career fields. There are many corporations beginning to work with states and local school systems in innovative projects and competitions. A national plan would enable best practices to be shared and would coordinate the many piecemeal efforts that are happening around the country.

Ultimately, collaborative action is needed at all levels to ensure the US workforce is capable of maintaining competitive advantage. While education is largely a state and locally run industry, the Federal government must play a leading role in bringing together all of the stakeholders to collectively address the industry's major challenges and secure our nation's future for the generations to come.

ESSAYS ON MAJOR ISSUES:

EDUCATION CHALLENGES IN SCIENCE AND TECHNOLOGY

INTRODUCTION

The Phase III Report of the United States (US) Commission on National Security for the 21st Century (also known as the Hart-Rudman Commission) concluded that "the U.S. need for the highest quality human capital in science, mathematics, and engineering is not being met."[46] It goes on to say that US global influence depends on its reputation for excellence in these areas and that it must remain at the cutting edge of science and technology to sustain its current world leadership.[47] Federal Reserve Chairman Alan Greenspan recently testified before Congress about the importance of science education to US economic vitality and homeland security.[48] The Council on Competitiveness, composed of industry, university, and labor leaders, has determined that "a well-educated and technically-trained workforce is essential to a nation's competitiveness."[49] Therefore, it is critical that the US education industry address these challenges to the nation's future in science and engineering.

DISCUSSION

There are a number of reasons for the need to increase production of highly educated US science and engineering graduates. First, the scientists and engineers of the baby-boom generation are beginning to retire. More than half of the scientists and engineers in the current workforce are older than 40.[50] The US enjoyed an extremely high level of science and engineering expertise during the second half of the 20th century: world-class scientists emigrated from Europe to the US; third-world war, instability, and poverty drove many foreign students to the US for graduate education and careers in science and engineering; and the US committed vast amounts of resources to educating and developing a superior science and engineering workforce to meet the challenges of the Cold War and information age.[51]

Second, the number of foreign students attending US universities to study science and engineering is declining. Growing global competition for scientific and engineering talent is increasing as other nations continue to develop more sophisticated science and technology capabilities.[52] Those foreign students that come here for their education are returning to their home-country workforces instead of gaining US citizenship and joining the US workforce, as had been the trend in the past.[53]

A third reason to increase the number of US-born science and engineering graduates is the security implications of relying on a foreign-born workforce to fill sensitive science and engineering positions in a post-9/11 environment.[54] National security implications for DoD-sponsored research at US universities and workforce requirements at DoD and security-related federal agencies point to the need for more US-born scientists and engineers to fill the gap.[55]

The National Science Foundation, in its 2004 Science and Engineering Indicators Report, confirmed that the US is facing a "science pipeline" crisis because it is not producing enough scientists and engineers.[56] A recent ACT policy report entitled "Maintaining a Strong Engineering Workforce" showed a drop in the percentage of high school seniors planning to study engineering from 9% in 1992 to 6% in 2002.[57] National

Science Foundation reports show a decrease, from 1994 to 2001, in the number of US citizens that enrolled in science and engineering graduate programs by as much as 20% in certain fields.[58] Based on current trends, the number of young Americans pursuing science and engineering degrees and careers will not meet the requirements of the 21st century.[59]

In order to find meaningful solutions to the science and engineering education problem, it is important to clearly identify the causes for the production shortfalls. One of the reasons young Americans are not pursuing science and engineering careers is the more enticing payoffs found in other career fields. In addition, the long and arduous preparation demanded in science and engineering education both stifles interest and causes many to change majors or pursue other careers upon graduation.[60] Less than half of those intending to major in science and engineering complete their degree within 5 years, with underrepresented minorities dropping out of these majors at an even higher rate.[61]

Another important reason for the lack of interest in science and engineering and the failure to develop the skills necessary to pursue advanced education in the field is the lack of highly qualified science teachers in US K-12 education systems. The creation of a healthy science pipeline must begin in the early elementary years and a key component to success is highly trained, effective teachers.[62]

The lack of qualified science and math teachers has resulted in teaching loads and class sizes that exceed optimum levels.[63] This leads to insufficient preparation time, lack of hands-on science activities, and having to utilize teachers who are ill prepared or not specifically qualified to teach science and math.[64] Over 34% of public school math teachers and almost 40% of science teachers lack even an academic minor in their primary teaching fields.[65] Further, these factors hinder the ability to foster interest in the sciences and generate the enthusiasm, exposure, and mentorship required to produce more scientists and engineers. The Hart-Rudman Commission estimated that the US requires more than 240,000 new qualified math and science teachers in grades K-12 over the next decade to fix the problem.[66] A continued shortage in the quantity and quality of science and math teachers will lead to a failure to produce the required number of highly qualified science and engineering students, graduates, and the next generation of science and math teachers.[67]

A prevailing problem that contributes to the previously mentioned causes of science and engineering education deficiencies is a lack of resources. Although the federal government provides significant resources to graduate education programs through fellowships and research grants, support to the other sectors of public education has come primarily from states, localities, and institutions of higher education.[68] States and local school districts often do not have the resources to provide the necessary programs and teachers required to promote high quality science and math education from elementary school through high school.[69]

RECOMMENDATIONS

Experts in the field have proposed numerous solutions to increase the production of well-educated scientists and engineers. Interest in science and engineering must be fostered beginning early in elementary school and then reinforced throughout middle school and high school.

For Inspiration and Recognition of Science and Technology (FIRST) sponsors one program that is making a difference. FIRST is a nonprofit corporation whose purpose is to excite young people about science and technology by involving professional mentors with high school students.[70] A recent robotics competition tapped into a local brain trust of engineers at Patuxant River Naval Air Station and area businesses to assist students with their projects and "light a fire in these kids that technology, math, and science are good."[71] Another recent competition demonstrates the potential of these types of programs. Eight national teams of students from kindergarten through 12th grade participated and earned prizes for developing new technologies that could be used in the future.[72] Called ExploraVision, it is designed to encourage students to discover and learn science through investigation and hands-on experience.[73]

Massachusetts has instituted changes that require engineering to be included as part of the K-12 curriculum.[74] The hope is that making information understandable through practical applications will produce a new generation of students who will love math and science.[75] Intel Corporation's Science Talent Search, America's oldest and most prestigious science competition, also relies on practical applications to increase student interest.[76] It is part of the Intel Innovation in Education initiative that seeks to improve the quality of math, science, and engineering education by providing commitments of time, programs and resources.[77] The talent search "challenges students to go beyond what they learn in the classroom and develop skills and confidence that will last them a lifetime."[78]

Another part of the solution to improve science and engineering education is to provide incentives to increase interest in pursuing study in these fields. The Hart-Rudman report goes so far as proposing programs that provide students summer jobs or internships at companies and foundations that provide endowments.[79] Another proposal suggests paying students at the high school level for taking advanced math and science courses. This compensation could come in the form of direct payment or scholarship money to apply towards college tuition.[80]

Magnet schools provide another means to increase student interest in science and engineering, cultivate that interest, and provide the challenges and quality education needed to produce future scientists and engineers. One such magnet school, Thomas Jefferson High School in Fairfax County, Virginia, provides an innovative, specialized learning environment for students interested in an intensive, challenging program focused on math, science, and technology.[81] The school is a result of a partnership between businesses and schools and attracts some of the finest students in the state. Students must have high ability, aptitude, and genuine interest in math, science, or technology.[82] Highly competitive magnet schools like this offer the best hope for maintaining and developing a superior science and engineering workforce by feeding the nation's college and university science and engineering programs with the best and brightest.

As discussed earlier, a lack of minority group science and engineering graduates is a critical problem. One way to increase the success of minority students in science and math is to engage educators, parents, and the students themselves. Parents must emphasize that education and academic success, coupled with hard work, are key to overcoming adversity. Educators must communicate high expectations. Students must have a strong support system at school that motivates them to work hard.[83]

The Meyerhoff Scholars Program at the University of Maryland, Baltimore County recruits and nurtures minority students who excel in math, science, and engineering by using these strategies. The program has become one of the nation's leading producers of minority graduates who go on to careers in science and technical fields.[84] Programs such as this must be utilized and expanded to increase minority participation and contributions to science and engineering.

The lack of highly qualified K-12 science and math teachers must be addressed if the US is to have any hope of meeting future science and engineering needs. There are a number of viable solutions proposed in the Hart-Rudman and National Science Board reports. First, compensation for math and science teachers must be increased to meet what equivalently educated professionals make in the private sector.[85] One option is increased Federal and state funding targeted at teachers' salaries. Another option is a merit pay system in which math and science teachers are paid more than others in lower demand subject areas that require fewer credentials and subject matter expertise. A third option is to establish public-private and community-wide partnerships that link universities and businesses with local school districts and provide endowments for higher teacher salaries in math and science.[86]

Recruiting and retention is another area that requires creative and flexible solutions. Fellowships to education certification programs, loan repayment reductions or cancellation options, and "signing bonuses" for entry-level science and engineering graduates are all positive actions that would increase teacher recruitment. To foster retention, math, science, and engineering teachers must be considered an integral part of the scientific and engineering professions.[87] New efforts must be undertaken to improve infrastructure support, teacher preparation programs, classroom training and mentorship, and professional development.[88] Administrative support and resources must ensure a disciplined and safe environment that restores professional status to teachers.[89] Undergraduate institutions must develop and support teacher preparation by integrating faculty and curricula from schools of science and engineering with schools of education.[90] Bayer Material Science's "Making Science Make Sense" initiative sponsors university programs that partner scientists and engineers with college students who are studying education.[91]

There are a number of initiatives in the classroom training, mentorship, and professional development areas that need to be shared and expanded. Establishing partnerships with universities and industry to bring science and engineering professionals into the K-12 education system as mentors and advisors would certainly help struggling math and science teachers to improve their command of the subject and apply innovative ways to teach it.[92] The Mathematics and Science Partnership program authorized in the No Child Left Behind Act works to ensure that school districts implement professional development programs for math and science teachers.[93] According to the National Science Board, the Eisenhower Program run by the DOE to meet professional development needs of science and math teachers is a program that works and should be expanded. In addition, summer institutes, professional enrichment sabbaticals, and distance learning are innovative ways to meet this need.[94]

Immigration of foreign-born scientists, engineers and students combined with substantial US investment in science and engineering education in the past created the world's premier science and engineering workforce. That workforce is shrinking due to

retirements, reductions in foreign-born graduates who remain in the US, and decreasing numbers of US-born science and engineering graduates. With the threat of a dwindling science and engineering workforce in the 21st century, the US education industry must meet the challenge to provide a sufficient number of science and engineering graduates for the future. Generating student interest in science and engineering during all phases of elementary and secondary education, increasing minority participation and achievement, and recruiting and retaining a highly qualified math and science teaching corps, are essential elements to maintaining US prowess in science and engineering. As the US Commission on National Security for the 21st Century warns, if the nation does not take action now "…complacency with our current achievement of national wealth and international power will put all of this at risk."[95]

AUTHOR: Lt Col Lou Zuccarello, USAF

NDEA 2006:MORE THAN DEFENSE EDUCATION?

INTRODUCTION

American prosperity is inextricably tied to our ability to ride the technology wave. Our technological innovations defeated the Evil Empire and birthed the information age that has enabled us to excel as the lone Super Power in an increasingly connected world. The state of America's science, technology, engineering and math (STEM) expertise should therefore be closely monitored to ensure our ability to capitalize on the innovations of the future. The mediocre results in international student tests, the pending STEM worker shortage created and masked by an aging workforce, and the lack of interest by America's youth, while recognized by experts in the government, academia and industry as a pending crisis, has not caught the attention of the American public at large. The last time a STEM crisis of this magnitude was brewing, the Sputnik launch provided the shock needed to pass the National Defense Education Act of 1958 (NDEA 1958). The NDEA 1958 formed the education foundation that has fueled our success. A similar systems approach should be developed to reverse the current crisis.

DISCUSSION

In response to the Soviet Sputnik launch, Congress legislated a full range of STEM "pipeline-filling" mechanisms to develop the skills essential for national defense.[96] These "pipeline-filling" mechanisms included incentives for K-12 schools, universities, STEM students, and STEM teachers. The effort was not only meant to provide the needed STEM workforce but also increase the supply of STEM teachers required to perpetuate the system.

"In less than a decade, American science education underwent a complete reformulation. Government money flowed in three critical directions: (1) to curriculum design groups; (2) to summer institutes for teacher training; and (3) to local school districts for the exclusive purchase of new curriculum material and equipment for science."[97] Its greatest achievement, however, was providing the education foundation to win the Space Race.

"The NDEA sparked a half-century of remarkable innovation and wealth creation – and it may help explain why approximately 60 percent of the CEOs of the Fortune 100

have science or engineering degrees."[98] Recruiting America's finest minds was possible because America took a systems approach with NDEA 1958 to encourage the development of the STEM workforce required.

A new NDEA for 2006 could be the solution to the shortage. The call for the NDEA 2006 has been widespread. From academia, a letter from the President of the Association of American Universities urged the Secretary of Defense to give high priority to defense basic research and education programs in the FY06 budget request.[99] He recognized the importance of the NDEA 1958 and concluded that "(it) is once again time to inspire the next generation of students and scholars to pursue these security-related fields."[100]

The American Electronics Association seconded the call. They recognized a major factor in our competitiveness; the technically skilled workforce created by "educating American youth in math and science and by welcoming, not shunning, highly-skilled talent from around the world."[101] Our competitiveness was ensured by the innovation that fuels our economy.[102] The call has also been heard in the halls of Congress. In recognition of the importance of the STEM workforce to national security, the Emerging Threats and Capabilities SubCommittee created a "science, mathematics and research for transformation (scholarship) to enhance training recruitment and retention of talented individuals who possess unique national security-related technical skills."[103] The Department of Defense has also recognized the pressures on our STEM workforce by supporting a re-invigorated NDEA for 2006. The National Defense Industrial Association (NDIA) has even laid out a strategy for success.

The association hosted a conference in late 2004 to develop the *Industry Position on Critical Workforce Skills.*[104] Their position included support for a reinvigorated National Defense Education Act in 2006 and presented a STEM 'pipeline filling' strategy.[105] The NDIA strategy provided the mechanisms necessary for a systems engineering approach to the fill the pipeline. These mechanisms include programs to *excite, attract, educate and assist, recruit,* and *retain* the STEM workforce. The initiatives to *excite* and *attract* form the foundation for this strategy.

The Department of Defense (DoD) has already implemented several programs that mimic the *excite* initiatives. The DoD Education Activity has adopted a hands-on learning experience program provided by the Materials World Modules (MWM). The MWM program uses materials science as a framework to teach science, math, technology and society, employing a systems engineering approach in contrast to compartmentalized traditional methods.[106] The pedagogy of MWM is summed up by *inquiry through design*.[107] "This approach unites the abstract, quantitative methods of scientific inquiry with the concrete methods of technological design, helping students develop and integrate these complementary skills in a unique way."[108]

All branches of the Armed Forces have invested in programs to strengthen America's STEM foundation. The most ambitious is the Naval Research – Science and Technology for America's Readiness (N-STAR) programs, which not only are designed to *excite*, but also *attract* students to STEM. The N-STAR programs include the *Virginia Demonstration Project.*[109] The project is designed to attract students to engineering programs by exposing them "early to the joys of creation through design, discovery through research and invention through hands-on experimentation."[110] The demo project will "culminate in a two week-long summer academic camp which will feature involvement in hands-on projects directed at solving problems of Navy interest and visits

to the Center's facilities."[111] The Navy expects this program to expand nationwide with the NDEA 2006 by FY11.[112] These programs are an investment in the future "to maintain our technological edge and prepare for our future defense needs."[113]

The Department of Defense *excite* and *attract* programs are aimed to prevent the looming STEM crisis. The initiatives supported provide a new curriculum approach coupled with access to state-of-the-art government laboratory facilities, key attributes to the NDEA 1958. While supported by DoD with funding starting at $10 million in FY06 and ramping to $62 million in FY11,[114] an integrated interagency approach to the NDEA 2006 has yet to be programmed. The National Science Federation expects a 12.4% reduction in STEM related programs to include an especially troubling $60M cut in the FY06 NSF Math and Science Partnerships.[115] The DOE funding looks more promising with a $90M increase in Math and Science Partnerships, but these funds are earmarked by the Administration "for competitive grants solely to math initiatives at the secondary level as part of the new High School Initiative", part of No Child Left Behind (NCLB).[116] The need for experiential hands-on STEM education essential in the eyes of DoD has not yet been adopted across all agencies.

If the government cannot develop a coherent interagency plan to strengthen the STEM workforce, how can we expect general public support without a Sputnik-like shock? The NDIA, once again, has provided an answer. To eliminate the STEM crisis without a shock, a public information campaign is required. NDIA recommends the launch of a "national public awareness/media campaign (TV show, commercials) around the importance of STEM/ foreign language education and avocation and the benefits of a national security career."[117] Such a campaign would require an integrated nationwide approach designed to improve the image of the STEM workforce and educate the common citizen about the benefit this workforce provides to the nation beyond national defense.

The awareness campaign must also focus on the beneficial externalities provided by innovation, which are enjoyed by more than the defense establishment. Industry, therefore, has a vested interest in the health of the STEM workforce. While this is key to the NDIA strategy, STEM initiatives sponsored by industry are sadly lacking. This was reinforced by a visit to Thomas Jefferson High School for Science and Technology. This high school was founded to lure high technology companies to the area. While numerous companies have partnered with the school, the partnership only provides mentorship opportunities and does not include any funding. Industry financial sponsorship does not support the anti-crisis rhetoric.

RECOMMENDATIONS

To make the NDEA 2006 a reality, the nation must be convinced that the upcoming STEM workforce crisis is not merely a military problem. A joint military, industry, and academic information campaign could accomplish this monumental task with the right champion. The DoD, however, is not the appropriate choice. The *excite* and *attract* initiatives are fundamental to not only the military, but the nation at large. To identify the right champion, we should look to the past. The NDEA 1958 was successful because it was championed at the highest levels. President Eisenhower mandated the previous effort and today's effort without the benefit of a shock requires at least the same level of support. The current administration, however, has its 'political' education capital

invested in NCLB. Unless the NDEA 2006 strategy can be integrated into and take advantage of NCLB, further financing for an additional major education initiative is simply asking too much.

With an information campaign focused on the economic benefits, enlisting an industrial champion might possibly succeed. An industry championed education revival could easily convince the public of the economic need for the NDEA 2006. However, CEOs expect someone else to pay for the beneficial externalities of education and technology. Without further incentives, expecting them to risk their companies' valuable profits is also asking too much.

The reality of the NDEA 2006 remains grounded in DoD's desire to minimize the impact of the upcoming crisis on national security and the STEM defense workforce. The current funding and policies are aimed at filling positions critical to the DoD even as national security STEM capabilities have been increasingly privatized. Only when the NDEA 2006 is championed by the President, like the previous act, can we expect the integrated government, industry, and academic approach required for national success. Until then, we can only hope that the next shock is as benevolent as Sputnik.

AUTHOR: Lt Col Roger Vincent, USAF

MUSIC AND ARTS EDUCATION IN OUR SCHOOLS

INTRODUCTION

"Live – from Pitt Stadium – the Pitt Band!" I can still hear those words echo through the stadium as thousands of fans cheer. The rush of adrenaline and surge of pride I felt every time I heard those words will be with me forever. Moments like that were made possible for me because I was fortunate enough to grow up in a school district that placed value in music and arts education from the beginning. It saddens me to think that the children of today may not have the same opportunity.

My opinion on the subject of music and arts education in our schools is obviously a biased one. My personal experience with music education has been an enriching one. That said, I will endeavor to persuade the reader, via information, research and statistics, to support my assertion that music and arts education are vital components of every student's overall education and should not be removed from the curriculum.

The educators of today are faced with external pressures on the system, the magnitude of which has never been experienced previously. Parents of today's students are typically both working full time and have very little time to be involved with the schools. No Child Left Behind (NCLB) legislation is requiring yearly increases to test scores in core areas of the curriculum. Although music and arts education are considered core curriculum areas by NCLB, there are currently no assessments required. Because progress is not being measured, music and arts education has dropped in priority. In the midst of all of these changes, our technology-based society is introducing new subject areas necessary for students to succeed in today's computer-driven world. All of these factors combine to strain budgets and create competition for equal time in the curriculum. Increasingly, schools are making the decision to decrease or eliminate music and arts education from the curriculum. According to U.S. Representative Danny K. Davis (Illinois) "Local budget cuts are depriving approximately 30 million students of an

education that includes music. It is not only at the local level that is forcing schools to abandon music education, but the lack of federal funding as well".[118] Noted educational researchers Ellen Winner and Lois Hetland caution against justifying music and art education based upon its side effects in other subjects. They remind us, "It is high time to state the right arguments for the arts in our schools and to begin to gather the right kind of evidence for those arguments. The best hope for the arts in our schools is to justify them by what the arts can do that other subjects cannot do as well, or cannot do at all".[119]

The National Association for Music Education (MENC) is an association of music teachers and individuals in music-related educational work. MENC provides a base of support for music education by bringing critical issues in music education to Capitol Hill and a variety of other national educational forums. MENC has grouped the benefits of music education into four categories: success in society, success in school, success in developing intelligence and success in life.[120]

- Success in Society
  The overall goal of education is "to prepare students for the working world, for their roles and responsibilities as citizens in a democracy, and to prepare them for life in an increasingly interdependent and culturally diverse world".[121] Music and art education prepares students to be responsible members of society in many ways. First, the study of the music and art of different cultures gives students an appreciation for both the similarities and the differences between themselves and citizens of other parts of the world. Second, students involved in music and the arts are less likely to engage in substance abuse. The Texas Commission on Drug and Alcohol Abuse reported, "Secondary students who participated in band or orchestra reported the lowest lifetime and current use of all substances (alcohol, tobacco, illicit drugs)".[122] Such a positive impact on students cannot be ignored when one is attempting to produce productive members of society. Next, there is an economic benefit to society. Nationally, nonprofit arts institutions generate $37 billion in economic activity and pay $3.4 billion in federal taxes each year, create jobs and encourage tourism.[123] Without continued support of music and arts education, institutions such as these will suffer. Finally, studies report that the arts nurture skills important to social interaction such as "empathy, collaboration, and tolerance for others".[124]

- Success in School
  There exists a plethora of statistical evidence linking music and arts education to success in other subject areas. These findings span socio-economic strata and continue to improve the longer a student participates in music and arts education. The U.S. Department of Education collected data on over 25,000 secondary school students and found that students highly involved in instrumental music in middle and high school show "significantly higher levels of mathematics proficiency by grade 12".[125] Students involved in music performance score 57 points higher on verbal and 41 points higher on math on the Scholastic Aptitude Test (SAT). Students taking music appreciation scored 63 points higher on verbal and 44 points higher on the math.[126]

- Success in Developing Intelligence
  Traits developed during music education, particularly musical performance are instrumental in developing intelligence. Musicians are making continuous decisions on tempo, tone, style, rhythm, phrasing and feeling throughout a performance. This decision making trains "the brain to become incredibly good at organizing and conducting numerous activities at once. Dedicated practice of this orchestration can have a great payoff for lifelong attentional skills, intelligence and an ability for self-knowledge and expression".[127] The most frequently recognized skill developed through music is spatial-temporal reasoning. Spatial-temporal reasoning is "the ability to flip or rotate or turn images in your head through sequential steps of problem-solving".[128] These skills are particularly useful to architects and engineers.[129] The University of California (Irvine) conducted a study of preschoolers, which showed that, after eight months of keyboard lessons, spatial reasoning IQ scores increased 46%.[130]

- Success in Life
  Music and art education offer some less measurable benefits that are more psychological than physiological. The pride, self-esteem and sense of accomplishment that results from participating in music and the arts are just a few of the intangible benefits. The self-discipline and persistence required to learn, practice and perform translate to life-long study and work habits. "Creating and performing music promotes self-expression and provides self-gratification while giving pleasure to others. In medicine, increasing published reports demonstrate that music has a healing effect on patients".[131] Music also has the power to bring people together. It has often been called a universal language. It can be a means of communication and understanding across cultures. During the Cold War, rock and roll music broadcast over the Voice of America radio station brought the ideas of freedom and democracy to the youth of the Soviet Union. Daniel Carp, Chairman and CEO of Eastman Kodak Company said "Music is one way for young people to connect with themselves, but it is also a bridge for connecting with others. Through music, we can introduce children to the richness and diversity of the human family and to the myriad rhythms of life".[132]

RECOMMENDATIONS

The House of Representatives passed a Concurrent Resolution on 1 March 2005 that said music instruction "is an important component of a well-rounded academic curriculum and should be available to every student in every school".[133] Congressional support, in addition to the inclusion of music and arts education in NCLB as part of the core curriculum are essential to the continuing struggle to keep music and arts in our schools. The pressures on the education system will not go away – in fact they are likely to increase. Justification for music and art education in our schools will continue to be necessary. The value of developing the whole child and the benefits music and arts education provide far outweigh the costs. Those of us who know first hand the difference music and arts can make have a responsibility to secure that opportunity for all children.

AUTHOR: Ms. Theresa Conte

ENDNOTES

[1] Jack E. Bowsher, *Fix Schools First*, (Maryland: Aspen Publications, 2001), 24-5.
[2] National Center for Education Statistics, *Digest of Education Statistics, 2003, Table 29. Total expenditures of educational institutions related to the gross domestic product, by level of institution: Selected years, 1929-30 to 2001-02,* <http://www.nces.ed.gov/programs/digest/> (November 2003).
[3] Bowsher, *Fix Schools First*, 19.
[4] National Center for Education Statistics, *Digest of Education Statistics, 2003, Table 5. Educational institutions, by level and control of institution: Selected years, 1980-81 to 2001-02,* <http://www.nces.ed.gov/programs/digest/> (September 2003).
[5] Ibid, Tables 3 and 4.
[6] Bill and Melinda Gates Foundation, *Education Program Fact Sheet*, February 2005, <http://gatesfoundation.org/Education/RelatedInfo/EducationFactSheet-021201.htm> (28 April 2005).
[7] Ibid.
[8] Jon Kyl, Republican Policy Committee, *Funding the No Child Left Behind Act: How Much is Enough?*, 15 November 2004, <http://kyl.senate.gov/> (April 2, 2005).
[9] Margaret Spellings, *US Secretary of Education, on the 2005 Advanced Placement Results*, January 2005, <http://www.ed.gov/news/pressreleases/2005/01/01252005.html> (27 April 2005).
[10] Rodger W. Bybee, and Elizabeth Stage, "No Country Left Behind," *Issues in Science and Technology Online*, <http://www.issues.org/issues/21.2/bybee.html>, Vol. 21, Iss. 2 (Winter 2005), 69-75.
[11] Gerald W. Bracey, "International Comparisons: Less Than Meets the Eye?" *Phi Delta Kappan*, Feb 2004. Vol. 85, Iss. 6 (Feb 2004), 477-478.
[12] National Center for Education Statistics, *International Education Indicators*, <http://nces.ed.gov/surveys/international/IntlIndicators/index.asp?SectionNumber=4&SubSectionNumber=1&IndicatorNumber=6> (27 April 2005).
[13] National Center for Education Statistics, *Digest of Education Statistics, 2003, Table 156. Revenues for public elementary and secondary schools,* <http://www.nces.ed.gov/programs/digest/d03/tables/dt156.asp> (28 April 2005).
[14] United States Census Bureau, *Table 212: Educational Attainment by Race and Hispanic Origin: 1960 to 2003*, <http://www.census.gov/prod/2004pubs/04statab/educ.pdf> (28 April 2005).
[15] Ibid.
[16] National Center for Education Statistics, *Digest of Education Statistics, 2003, Table 107. Percent of high school dropouts,* <http://www.nces.ed.gov/programs/digest/d03/tables/dt107.asp> (28 April 2005).
[17] National Center for Education Statistics, *Digest of Education Statistics, 2003, Table 104. Public high school graduates and dropouts,* <http://www.nces.ed.gov/programs/digest/d03/tables/dt104.asp> (26 April 2005).
[18] Jay P. Greene and Marcus A. Winters, The Manhattan Institute for Policy Research, *Public High School Graduation and College-Readiness Rates: 1991–20,* <http://www.manhattan-institute.org/html/ewp_08.htm> (26 April 2005).
[19] Jack E. Bowsher, *Fix Schools First*, (Maryland: Aspen Publications, 2001), 36.
[20] The Council of Great City Schools, *Beating the Odds: III*, March 2003, <http://www.cgcs.org/reports/beat_the_oddsIII.html> (30 April 2005).
[21] Ibid.
[22] Jay P. Greene and Marcus A. Winters, The Manhattan Institute for Policy Research, *Public High School Graduation and College-Readiness Rates: 1991–2002,* <http://www.manhattan-institute.org/html/ewp_08.htm> (30 April 2005).
[23] Kathleen T. Jorissen, "Retaining Alternate Route Teachers: The Power of Professional Integration in Teacher Preparation and Induction," *The High School Journal*, (Oct/Nov 2002), 46.
[24] *Yearbook 2001: The state of America's children*, (Washington, D.C.: Children's Defense Fund, 2001), 66.
[25] Jerry Aldridge and Renitta Goldman, *Current Issues and Trends in Education*, (Boston: Allyn & Bacon, Pearson Education Company, 2002), 20.
[26] Newt Gingrich, *Winning the Future, A 21st Century Contract with America*, (Washington, D.C.: Regency Publishing, Inc., 2005), 143.

[27] John Boehner, "Implementing the No Child Left Behind Act: A Progress Report," *House Education and The Workforce Committee Fact Sheet*. 10 October 2003, Online, (2 April 2005).
[28] Derek Furr, "Leave No Child Behind?" *Education Week*. 31 October 2001, <http://www.edweek.org> (2 April 2005).
[29] Byron L. Dorgan, "Republicans Leave Behind Children and Families During the 108th Congress," Democratic Policy Committee, 7 October 2004, Online, (2 April 2005).
[30] Jon Kyl, "Funding the No Child Left Behind Act: How Much is Enough?" Republican Policy Committee, 15 November 2004, Online, (2 April 2005).
[31] John Boehner, "Implementing the No Child Left Behind Act: A Progress Report".
[32] Michael L. Marshall, Timothy Caffey, Fred E. Saalfeld, and Rita R. Colwell, "The Science and Engineering Workforce and National Security, *Defense Horizons*, April 2004, 4.
[33] The Phase III Report of the United States Commission on National Security/21st Century, *Road Map for National Security: Imperative for Change*, (Washington DC: United States Commission on National Security/21st Century, January 31, 2001), 39.
[34] Samuel P. Huntington, "The Hispanic Challenge," *Foreign Policy*, Mar/Apr 2004, 30.
[35] United States Census Bureau, *Table 1a. Projected Population of the United States, by Race and Hispanic Origin: 2000 to 2050*, <http://www.census.gov/ipc/www/usinterimproj/natprojtab01a.pdf> (30 April 2005).
[36] "Spellings Test," *Washington Post*, 23 April 2005, A18.
[37] Byron L. Dorgan, "Republicans Leave Behind Children and Families During the 108th Congress", Democratic Policy Committee, 7 October 2004, Online, Internet, (2 April 2005).
[38] The Phase III Report of the United States Commission on National Security/21st Century, *Road Map for National Security: Imperative for Change*, 30.
[39] US Department of Education, "Fiscal Year 2005 Budget Summary", 2 Feb 2004, <http://www.ed.gov/about/overview/budget/budget05/summary/edlite-appendix3.html> (27 Apr 2005).
[40] Amendment X to the Constitution of the United States of America, ratified 15 December 1791.
[41] National Center for Education Statistics, "NAEP Overview," <http://nces.ed.gov/nationsreportcard/about/>, 25 May 2005.
[42] US Department of Education, "No Child Left Behind - A Toolkit for Teachers", May 2004, 13-14.
[43] "Districts and Teachers' Union Sue Over Bush Law", *The New York Times*, 21 April 2005.
[44] Sam Dillion, "Utah Vote Rejects Parts of Education Law," *The New York Times*, 20 April 2005.
[45] US Department of Education, "No Child Left Behind – A Toolkit for Teachers", 3.
[46] The Phase III Report of the United States Commission on National Security/21st Century, *Road Map for National Security: Imperative for Change* (Washington DC: United States Commission on National Security/21st Century, January 31, 2001), 30.
[47] Ibid.
[48] Gregory S. Babe, "The Secret to a Healthy Science Pipeline Should Be Elementary," *Machine Design*, 17 February 2005, Vol. 77, Iss. 4, 211.
[49] Michael L. Marshall, Timothy Caffey, Fred E. Saalfeld, and Rita R. Colwell, "The Science and Engineering Workforce and National Security, *Defense Horizons*, April 2004, 3.
[50] Ibid.
[51] Newt Gingrich, *Winning the Future: A 21st Century Contract With America* (Washington DC: Regency Publishing, Inc., 10 January 2005), 146.
[52] Michael L. Marshall, Timothy Caffey, Fred E. Saalfeld, and Rita R. Colwell, "The Science and Engineering Workforce and National Security, p. 1.
[53] Fiona M. Goodchild, "The Pipeline: Still Leaking", *American Scientist*, Mar/Apr 2004, Vol. 92, Iss. 2, 112.
[54] National Science Board, *The Science and Engineering Workforce Realizing America's Potential* (Washington DC: National Science Foundation, August 14, 2003), p. 21.
[55] Michael L. Marshall, Timothy Caffey, Fred E. Saalfeld, and Rita R. Colwell, "The Science and Engineering Workforce and National Security, p. 5.
[56] Gregory S. Babe, "The Secret to a Healthy Science Pipeline Should Be Elementary," p. 211.
[57] Michael L. Marshall, Timothy Caffey, Fred E. Saalfeld, and Rita R. Colwell, "The Science and Engineering Workforce and National Security, 4.
[58] Ibid.

[59] Michael L. Marshall, Timothy Caffey, Fred E. Saalfeld, and Rita R. Colwell, "The Science and Engineering Workforce and National Security, 4.
[60] Ibid.
[61] National Science Board, *The Science and Engineering Workforce Realizing America's Potential*, p. 18.
[62] Gregory S. Babe, "The Secret to a Healthy Science Pipeline Should Be Elementary," p. 211.
[63] Ibid.
[64] Ibid.
[65] Ibid., 39.
[66] Ibid.
[67] Ibid., 40.
[68] National Science Board, *The Science and Engineering Workforce Realizing America's Potential*, 17.
[69] Ibid.
[70] Theola Labbe, "Engineering Contest Challenges Students to Build Robot, Skills; Solving Problems Together as Team," *The Washington Post*, February 24, 2002, T.01.
[71] Ibid.
[72] Tal Barak, "Competition Inspires Students To Be Innovative," *Education Week*, June 23, 2004, Online. www.edweek.org/ew/articles/2004/06/23/41inventions.h23.html.
[73] Ibid.
[74] Mark Clayton, "Engineering A Livelier Way To Study Science," *The Christian Science Monitor*, February 20, 2001, 14.
[75] Ibid.
[76] M2 Presswire, "INTEL: Intel Honors the Next Generation of Scientists," *Coventry*, January 29, 2003, 1.
[77] Ibid.
[78] Ibid.
[79] The Phase III Report of the United States Commission on National Security/21st Century, *Road Map for National Security: Imperative for Change*, 44.
[80] Ibid.
[81] Thomas Jefferson High School For Science and Technology, *Information for Applicants* (Fairfax, VA: Fairfax County Public Schools), 4.
[82] Ibid.
[83] Ibid., 45.
[84] Ibid., 46.
[85] The Phase III Report of the United States Commission on National Security/21st Century, *Road Map for National Security: Imperative for Change*, 44.
[86] Ibid.
[87] National Science Board, *The Science and Engineering Workforce Realizing America's Potential*, 32.
[88] Ibid.
[89] The Phase III Report of the United States Commission on National Security/21st Century, *Road Map for National Security: Imperative for Change*, 45.
[90] National Science Board, *The Science and Engineering Workforce Realizing America's Potential*, p. 32.
[91] Gregory S. Babe, "The Secret to a Healthy Science Pipeline Should Be Elementary," 211.
[92] Fiona M. Goodchild, "The Pipeline: Still Leaking," 112.
[93] The White House, "Strengthening Higher Education for a Successful Workforce," March 23, 2005, Online. www.whitehouse.gov/infocus/education/.
[94] National Science Board, *The Science and Engineering Workforce Realizing America's Potential*, 42.
[95] The Phase III Report of the United States Commission on National Security/21st Century, *Road Map for National Security: Imperative for Change*, 30.
[96] William P. Butz, Terrence K. Kelly, David M. Adamson, Gabrielle A. Bloom, Donna Fossum, and Mihal E. Gross, "Will the Scientific and Technology Workforce Meet the Requirements of the Federal Government?" *RAND Science and Technology*, <http://www.rand.org/pubs/monographs/2004/RAND_MG118.pdf>, 71.
[97] Ibid., 74.
[98] "Innovate America," National Innovation Initiative Report: Thriving in a world of challenge and change, Council on Competitiveness, Dec 04, <http://www.compete.org/pdf/NII_Final_Report.pdf>

[99] "AAU and NASULGC Urge Increased Funding For Defense Research and Education in FY06," AAU CFR Weekly Wrap-Up, The Association of American Universities, <http://www.aau.edu/publications/WR.11.5.04.pdf>
[100] Ibid.
[101] "Losing the Competitive Advantage? The Challenge for Science and Technology in the United States," AeA, Advancing the Business of Technology, <www.aeanet.org>, Feb 2005, 23.
[102] Ibid.
[103] "U.S. Senator John Cornyn (R-TX) Holds Hearing on the Fiscal Year 2006 Defense Science and Technology Budget," *Veritude: Strategic Human Resources*, LexisNexis, Copyright 2005 Congressional Quarterly, Inc. All Rights Reserved. FDCH Political Transcripts. 9 Mar 05 Wednesday.
[104] "Industry Position on Critical Workforce Skills: Quick-Look Report." *National Defense Industrial Association*, As presented to Dr. Sega, Director, Defense Research and Engineering, 31 Aug 04.
[105] Ibid., Slide 27.
[106] "Program Philosophy," *Materials World Modules*, Northwestern University, <http://materialsworldmodules.org/aboutmwm/programphilosophy.htm>, Feb 2005.
[107] "Pedagogy," *Materials World Modules*, Northwestern University, <http://materialsworldmodules.org/aboutmwm/pedagogy.htm>, Feb 2005.
[108] Ibid.
[109] Robert L. Stiegler and Eugene F. Brown, "Virginia Demonstration Project Management Plan," *Naval Research – Science and Technology for America's Readiness*, Rev 012605, <http://www.me.vt.edu/eugenebrown/VDPManagementPlanRev012605%20_3_.pdf>, 5 Jan 2005.
[110] Ibid., 1.
[111] Ibid.
[112] Ibid., 6.
[113] Ibid.
[114] "National Defense Education Act," *RDT&E Budget Item Justification Sheet*, Feb 05. <http://www.dod.mil/comptroller/defbudget/fy2006/budget_justification/pdfs/rdtande/OSD_BA_(All)/OSD%20BA1.pdf>
[115] "Administration FY2006 Budget Request Contains Cuts to Science and Math Education Programs at NSF," *NSTA Legislative Update*, National Science Teachers Association, 14 Feb 2005. <http://science.nsta.org/nstaexpress/nstaexpress_2005_02_14_legupdate.htm>
[116] Ibid.
[117] "Summary of Workshop Results: Breakout Session Summary," *Workshop on National Security Workforce Challenges and Solutions*, National Defense Industry Association, 22 Dec 2004, Slide 25. <http://proceedings.ndia.org/534E/Summary_of_Workshop.pdf>
[118] International Music Products Association, (Spring 2002), <http://www.menc.org/information/advocate/facts.html>, 31 March 2005, 1.
[119] Ellen Winner and Lois Hetland, "Does Studying the Arts Enhance Academic Achievement?", *Education Week*, (1 November 2000), <http://www.edweek.org>, 24 February 2005, 3.
[120] MENC – The National Association for Music Association, "Music Education Facts and Figures", (Spring 2002), <http://www.menc.org/information/advocate/facts.html>, 31 March 2005, 1.
[121] NASBE: National Association of State Boards of Education, Lori Meyer, Project Director, "The Complete Curriculum: Ensuring a Place for the Arts and Foreign Language in America's Schools", Study Group on the Lost Curriculum, (Winter 2004), <http://www.supportmusic.com/public/browse.php?soc,>, 31 March 2005,1.
[122] Texas Commission on Drug and Alcohol Abuse Report. Reported in *Houston Chronicle*, January 1998, 2.
[123] American Arts Alliance Fact Sheet, (October 1996), <http://www.menc.org/information/advocate/facts.html>, 31 March 2005, 2.
[124] Richard J. Deasy and Lauren Stevenson, "The Arts: Critical Links to Student Success", (16 May 2002), <http://www.aep-arts.org>, 31 March 2005,1.
[125] James S. Catterall, Richard Chapleau, and John Iwanaga, "Involvement in the Arts and Human Development: General Involvement and Intensive Involvement in Music and Theater Arts", (Los Angeles, CA: The Imagination Project at UCLA Graduate School of Education and Information Studies, 1999), 2.

[126] College Bound Seniors National Report: Profile of SAT Program Test Takers, (Princeton, NJ: The College Entrance Examination Board, 2001), 2.
[127] John J. Ratey, MD, *A User's Guide to the Brain*, (New York: Pantheon Books, 2001), 4.
[128] Mary Ann Zehr, "'Mozart Effect' Goes Only So Far, Study Says", *Education Week*, (27 September 2000), <http://www.edweek.org>, 24 February 2005, 1.
[129] Debra Viadero, "Research Notes: Music and Math", *Education Week*, (14 April 1999), http://www.edweek.org>, 24 February 2005, 1.
[130] Rauscher, Shaw, Levine, Ky and Wright, "Music and Spatial Task Performance: A Causal Relationship", (Irvine, CA: University of California - Irvine, 1994), 5.
[131] MENC, "Music Education Facts and Figures", 6.
[132] Ibid.
[133] US House of Representatives, Congressional Resolution 45, 1 March 2005.

BIBLIOGRAPHY

"AAU and NASULGC Urge Increased Funding For Defense Research and Education in FY06." AAU CFR Weekly Wrap-Up. The Association of American Universities. Accessed Apr 05. <http://www.aau.edu/publications/WR.11.5.04.pdf>

"Administration FY2006 Budget Request Contains Cuts to Science and Math Education Programs at NSF." NSTA Legislative Update. National Science Teachers Association. 14 Feb 05. Accessed Mar 05. <http://science.nsta.org/nstaexpress/nstaexpress_2005_02_14_legupdate.htm>

Aldridge, Jerry and Renitta Goldman. *Current Issues and Trends in Education*. Boston: Allyn & Bacon, Pearson Education Company, 2002.

Amendment X to the Constitution of the United States of America, ratified 15 December 1791.

American Arts Alliance Fact Sheet. (October 1996): 2pp. Online. Internet. 31 March 2005.

Anonymous, (2005). "Alternative Teacher Certification", *Education Week, Research Center*. 2005 Editorial Projects in Education. Internet. Online. www.edweek.org accessed March 23, 2005.

Babe, Gregory S. "The Secret to a Healthy Science Pipeline Should Be Elementary." *Machine Design*. 17 February 2005, Vol. 77, Iss. 4.

Barak, Tal. "Competition Inspires Students To Be Innovative." *Education Week.* June 23, 2004. Online. www.edweek.org/ew/articles/2004/06/23/41inventions.h23.html.

Bassett, Patrick F. (2003). "Searching for Great Teachers", *Education Week*, February 26, 2003, Volume 22, Issue 24, Pages 26,28. Internet. Online. www.edweek.org accessed February 24, 2005.

Blair, Julie (2001). "New Organization Aims to Develop Tests for Teachers", *Education Week*, October 17, 2001, Volume 21, Issue 7, Pages 1,16. Internet. Online. www.edweek.org accessed February 24, 2005.

Blair, Julie (2001). "Critics Question Federal Funding of Teacher Test", *Education Week*, October 8, 2003, Volume 23, Issue 6, Pages 1,17. Internet. Online. www.edweek.org accessed February 24, 2005.

Bill and Melinda Gates Foundation. Education Program Fact Sheet, February 2005, <http://gatesfoundation.org/Education/RelatedInfo/EducationFactSheet-021201.htm> (28 April 2005).

Boehner, John. "Implementing the No Child Left Behind Act: A Progress Report." House Education and the Workforce Committee Fact Sheet. October 10, 2003. Online. Internet. April 2, 2005.

Bowsher, Jack E. *Fix Schools First*. Maryland: Aspen Publications, 2001.

Bracey, Gerald W. "International Comparisons: Less Than Meets the Eye?" Phi Delta Kappan, Feb 2004. Vol. 85, Iss. 6 (Feb 2004), 477-478.

Bybee, Rodger W. and Elizabeth Stage. "No Country Left Behind," Issues in Science and Technology Online, <http://www.issues.org/issues/21.2/bybee.html>, Vol. 21, Iss. 2 (Winter 2005), 69-75.

Butz, William P., Terrence K. Kelly, David M. Adamson, Gabrielle A. Bloom, Donna Fossum, and Mihal E. Gross. "Will the Scientific and Technology Workforce Meet the Requirements of the Federal Government?" RAND Science and Technology. Accessed Feb 05. <http://www.rand.org/pubs/monographs/2004/RAND_MG118.pdf>

Catterall, James S., Richard Chapleau, and John Iwanaga. "Involvement in the Arts and Human Development: General Involvement and Intensive Involvement in Music and Theater Arts." Los Angeles, CA: The Imagination Project at UCLA Graduate School of Education and Information Studies, 1999.

Clayton, Mark. "Engineering A Livelier Way To Study Science." *The Christian Science Monitor*. February 20, 2001.

College Bound Seniors National Report: Profile of SAT Program Test Takers. Princeton, NJ: The College Entrance Examination Board, 2001.

Darling-Hammond, Linda (2000). "Teacher Quality and Student Achievement: A Review of State Policy Evidence", *Education Policy Analysis Archives*, January 1, 2000, Volume 8, Number 1, ISSN 1068-2341. Internet. Online. www.epaa.asu.edu accessed March 13, 2005.

DeArmond, Michael and Goldhaber, Dan (2003). "The Back Office – A Neglected Side of Teacher Quality", *Education Week*, February 9, 2005, Volume 24, Issue 22, Pages 31-32. Internet. Online. www.edweek.org accessed March 23, 2005.

Deasy, Richard J. and Lauren Stevenson. "The Arts: Critical Links to Student Success". (16 May 2002): 3pp. Online. Internet. 31 March 2005.

Dillion, Sam. "Utah Vote Rejects Parts of Education Law." *The New York Times*. 20 April 2005.

"Districts and Teachers' Union Sue Over Bush Law". *The New York Times*. 21 April 2005.

Dorgan, Byron L. "Republicans Leave Behind Children and Families During the 108th Congress." Democratic Policy Committee. October 7, 2004. Online. Internet. April 2, 2005.

Dobbs, Michael (2004). "Montana's Top Teacher Not Good Enough; No Child Left Behind Law Confounds States; US Officials Says It's Misunderstood", *The Washington Post*, March 14, 2004, Page A.07. Internet. Proquest accessed March 17, 2005.

Fu, Jennifer (2005). "New Recruiting Efforts by Teach for America Yield Record Applicants", *Education Week*, March 16, 2005, Volume 24, Issue 27, Page 9. Internet. Online. www.edweek.org accessed March 16, 2005.

Gingrich, Newt. *Winning the Future, A 21st Century Contract with America*. Washington, D.C.: Regency Publishing, Inc., 2005.

Goodchild, Fiona M. "The Pipeline: Still Leaking". *American Scientist*. Mar/Apr 2004. Vol. 92, Iss. 2.

Greene, Jay P. and Marcus A. Winters, The Manhattan Institute for Policy Research, Public High School Graduation and College-Readiness Rates: 1991–2002, <http://www.manhattan-institute.org/html/ewp_08.htm> (26 April 2005).

Hrabowski III, Freeman A. "Raising Minority Achievement in Science and Math." *Educational Leadership*. Dec/Jan 2003. Vol. 60, Iss. 4.

Huntington, Samuel P. "The Hispanic Challenge," Foreign Policy, Mar/Apr 2004.

"Industry Position on Critical Workforce Skills." National Defense Industrial Association. As presented to Dr. Sega, Director, Defense Research and Engineering. 31 Aug 04. Accessed Jan 05. <http://proceedings.ndia.org/4340/swallow.pdf>

"Innovate America." National Innovation Initiative Report: Thriving in a world of challenge and change. Council on Competitiveness. Dec 04. Accessed Mar 05. < http://www.compete.org/pdf/NII_Final_Report.pdf>

Jackson, Dr. Shirley Ann. President, Rensselaer Polytechnic Institute. "The Perfect Storm." Speech to the National Society of Black Engineers Dallas, Texas. 17 Mar 04.

Jacobson, Linda (2005). "Federal Officials Say N.D., Utah Teachers 'Qualified' After All", *Education Week*, March 9, 2005, Volume 24, Issue 26, Page 20. Internet. Online. www.edweek.org accessed March 9, 2005.

Jorissen, Kathleen T. "Retaining Alternate Route Teachers: The Power of Professional Integration in Teacher Preparation and Induction." *The High School Journal*. Oct/Nov 2002.

Keller, Bess (2003). "Teacher Quality Might Be More Elusive Than Cited", *Education Week*, November 12, 2003, Volume 23, Issue 11, Page 10. Internet. Proquest, accessed February 24, 2005.

Kyl, Jon. Republican Policy Committee, Funding the No Child Left Behind Act: How Much is Enough?, 15 November 2004, <http://kyl.senate.gov/> (April 2, 2005).

Labbe, Theola. "Engineering Contest Challenges Students to Build Robot, Skills; Solving Problems Together as Team." *The Washington Post.* February 24, 2002.

"Losing the Competitive Advantage? The Challenge for Science and Technology in the United States." AeA, Advancing the Business of Technology. Feb 05. p23. Accessed Apr 05. <www.aeanet.org>

M2 Presswire. "INTEL: Intel Honors the Next Generation of Scientists." *Coventry.* January 29, 2003.

Marshall, Michael L., Caffey, Timothy, Saalfeld, Fred E., and Colwell, Rita R., "The Science and Engineering Workforce and National Security," Defense Horizons, April 2004.

Maryland Department of Education Website. Internet. Online. www.msde.state.md.us accessed April 3, 2005.

Materials World Modules. Northwestern University. Accessed Apr 05. <http://materialsworldmodules.org/aboutmwm/history.htm>

MENC – The National Association for Music Association. "Music Education Facts and Figures". (Spring 2002): 7pp. Online. Internet. 31 March 2005.

Moe, Terry M. (2005). "No Teacher Left Behind", *The Wall Street Journal*, January 13, 2005, Page A.12. Internet. Proquest accessed March 17, 2005.
NASBE: National Association of State Boards of Education. Lori Meyer, Project Director. "The Complete Curriculum: Ensuring a Place for the Arts and Foreign Language in America's Schools". Study Group on the Lost Curriculum, Winter 2004.

National Center for Education Statistics, Digest of Education Statistics, 2003, <http://www.nces.ed.gov/programs/digest/d03/tables/> (28 April 2005).

National Center for Education Statistics, International Education Indicators, <http://nces.ed.gov/surveys/international/IntlIndicators/index.asp?SectionNumber=4&SubSectionNumber=1&IndicatorNumber=6> (27 April 2005).

National Center for Education Statistics, "NAEP Overview," <http://nces.ed.gov/nationsreportcard/about/>, (25 May 2005).

"National Defense Education Act." RDT&E Budget Item Justification Sheet. Feb 05. Accessed Apr 05.
<http://www.dod.mil/comptroller/defbudget/fy2006/budget_justification/pdfs/rdtande/OSD_BA_(All)/OSD%20BA1.pdf>

National Science Board. *The Science and Engineering Workforce Realizing America's Potential*. Washington DC: National Science Foundation, August 14, 2003.

Ratey, John J., MD. A User's Guide to the Brain. New York: Pantheon Books, 2001.

Rauscher, Shaw, Levine, Ky and Wright, "Music and Spatial Task Performance: A Causal Relationship". Irvine, CA: University of California - Irvine, 1994.

"Road Map for National Security: Imperative for Change." The Phase III Report of the U.S. Commission on National Security/21st Century. 15 Feb 01. Accessed Mar 05. <http://govinfo.library.unt.edu/nssg/PhaseIIIFR.pdf>

Ruark, Jennifer (2003) "Improving Education by Valuing Teachers as Professionals". *The Chronicles of Higher Education*, May 2, 2003, Volume 49, Issue 34, Page A22. Internet. Online. www.chronicle.com accessed March, 2005.

Schroeder, Ken. "Women and Minorities". *The Education Digest.* December 2002. Vol. 68, Iss. 4.

Spellings, Margaret. US Secretary of Education, on the 2005 Advanced Placement Results, January 2005, <http://www.ed.gov/news/pressreleases/2005/01/01252005.html> (27 April 2005).

"Spellings Test," Washington Post, April 23, 2005.

Stiegler, Robert L. and Eugene F. Brown. "Virginia Demonstration Project Management Plan." Naval Research – Science and Technology for America's Readiness. Rev 012605. 5 Jan 05. Accessed Mar 05. <http://www.me.vt.edu/eugenebrown/VDPManagementPlanRev012605%20_3_.pdf>

"Summary of Workshop Results: Breakout Session Summary." Workshop on National Security Workforce Challenges and Solutions. National Defense Industry Association. 22 Dec 04. Accessed Jan 05. <http://proceedings.ndia.org/534E/Summary_of_Workshop.pdf>

Swallow, Edward. Chair, NDIA Space Division &Chair, Industry Study on Critical Workforce Issues, supporting Dr. Ron Sega, Director of Defense Research and Engineering. "Space Policy and Architecture Conference: Space Industrial Base Panel." Accessed Apr 05. <http://proceedings.ndia.org/4340/swallow.pdf>

"Teacher Retention, How The Courage to Teach responds to the challenge of keeping and sustaining our public school teachers," School Information System, <http://www.schoolinfosystem.org/pdf/102004/ctt_retention.pdf>. 20 March 2005.

"Teacher Retention Strategies," Nobscot Corporation, <http://www.nobscot.com/about/teacher_retention_strategies.cfm>. 20 March 2005.

Texas Commission on Drug and Alcohol Abuse Report. Reported in *Houston Chronicle*, January 1998.

The Council of Great City Schools, Beating the Odds: III, March 2003, <http://www.cgcs.org/reports/beat_the_oddsIII.html> (30 April 2005).

"The Defense Science Board 2001 Summer Study on Defense Science and Technology." Office of the Under Secretary of Defense for Acquisition, Technology and Logistics. Washington D.C. 20301-3140. May 02. Accessed Mar 05. <http://www.acq.osd.mil/dsb/reports/sandt.pdf>

The Phase III Report of the United States Commission on National Security/21st Century, Road Map for National Security: Imperative for Change (Washington DC: United States Commission on National Security/21st Century, January 31, 2001).

The White House. "Strengthening Higher Education for a Successful Workforce." March 23, 2005. Online. www.whitehouse.gov/infocus/education/.

Thomas Jefferson High School For Science and Technology. *Information for Applicants.* Fairfax, VA: Fairfax County Public Schools.

United States Census Bureau, Table 1a. Projected Population of the United States, by Race and Hispanic Origin: 2000 to 2050, <http://www.census.gov/ipc/www/usinterimproj/natprojtab01a.pdf> (30 April 2005).

United States Census Bureau, Table 212: Educational Attainment by Race and Hispanic Origin: 1960 to 2003, <http://www.census.gov/prod/2004pubs/04statab/educ.pdf> (28 April 2005).

US Department of Education. "Fiscal Year 2005 Budget Summary". 2 Feb 2004. <http://www.ed.gov/about/overview/budget/budget05/summary/edlite-appendix3.html> 27 Apr 2005.

US Department of Education. "No Child Left Behind - A Toolkit for Teachers". May 2004.

US Department of Education. The Secretary's Third Annual Report on Teacher Quality (2004). "Meeting the Highly Qualified Teacher's Challenge, 2004". Washington, D.C.

US House of Representatives. Congressional Resolution 45. 1 March 2005.

"U.S. Senator John Cornyn (R-TX) Holds Hearing on the Fiscal Year 2006 Defense Science and Technology Budget." Veritude: Strategic Human Resources. LexisNexis. Copyright 2005 Congressional Quarterly, Inc. All Rights Reserved. FDCH Political Transcripts. 9 Mar 05 Wednesday. http://www6.lexisnexis.com/publisher/EndUser?Action=UserDisplayFullDocument&orgId=1727&topicId=100000614&docId=l:264773949&start=13

Usdan, Michael D. (2004). "Teaching Commissions, Then and Now", *Education Week*, March 31, 2004, Volume 23, Issue 29, Page 36. Internet. Online, www.edweek.org accessed February 24, 2005.

Viadero, Debra. "Research Notes: Music and Math". Education Week. (14 April 1999): 3pp. Online. Internet. 24 February 2005.

Winner, Ellen and Lois Hetland. "Does Studying the Arts Enhance Academic Achievement?". Education Week. (1 November 2000): 4pp. Online. Internet. 24 February 2005.

Wise, Arthur E. (2003). "What's Wrong With Teacher Certification?", *Education Week*, April 9, 2003, Volume 22, Issue 30, Pages 42,56. Internet. Online, www.edweek.org accessed February 24, 2005.

Yearbook 2001: The state of America's children. Washington, D.C.: Children's Defense Fund, 2001.

Zehr, Mary Ann. "'Mozart Effect' Goes Only So Far, Study Says". Education Week. (27 September 2000): 3pp. Online. Internet. 24 February 2005.