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ADVANCED ACHIEVEMENT IN STEM FIELDS: ESSENTIALS FOR SUCCESS

The Problem

With continuing national security, defense, and economic issues facing the nation, a strong education for Americans in science, technology, engineering, and mathematics (STEM) is more crucial than ever. Students in the STEM fields provide the workforce for vital defense and intelligence community jobs, as well as supplying the great innovators in private industry working on new technologies. However, there is abundant evidence that U.S. students are not being prepared to compete for seats in our most prestigious universities that produce future scientists, mathematicians, and engineers. In a global economy where jobs and business development cross borders, this is increasingly a matter of concern.

On the most recent international PISA[1] exam, 24 countries outperformed U.S. students on the mathematics literacy test, students in 13 countries performed better on the reading test, and 16 countries performed better on the science literacy test. At best, U.S. students are average performers.

Achievement by high-ability students has been languishing for years. When the Thomas Fordham Institute looked at data from the National Assessment of Educational Progress (NAEP) exam, it found that in the last decade since the passage of No Child Left Behind, lowest performing students have made learning improvements while the nation's highest performing students have made almost no learning gains.

For high-potential, low-income students the problem is especially troublesome.

- Between 1996 and 2007, The percentage of students eligible for free school lunches who scored at the advanced level on the NAEP mathematics exam in 4th grade increased by 1.2% to 1.5%, while there was a 5.6% increase to a total of 8.8% by their wealthier age-mates who scored at the advanced level in the same time period[2]
- Of advanced math students starting high school, only 75% of low-income students remain in the top quartile by the end of high school, compared to 84% of their more advantaged peers.[3]

Keys to Developing Talent

Developing talent for the nation's future begins in our K-12 schools. Math and science experts have repeatedly called for federal leadership to build both a STEM-proficient workforce and to cultivate future experts and innovators. To accomplish both of these goals, schools must raise the learning floor for all children **and** raise the ceiling for those students capable of achieving at the highest levels. Although these recommendations focus on the STEM fields, with modification they could be adapted for use across every content area as a true, national talent development strategy.

Casting a Wide Net

Currently, a high-ability student's zip code is the determining factor in whether his or her educational needs are being met. Declining resources and competing priorities coupled with the lack of understanding of giftedness widen the chasm of availability, access, and quality of services for our brightest students. Too often, young talent goes unrecognized and undeveloped, which often leads to boredom, underachievement, and increased drop-out rates,[4] which is a loss for both the student and the community. To improve our ability to recognize and develop talent in a systematic way we should:

- Increase access to above grade-level assessments, especially in economically disadvantaged communities[5] to improve student identification for advanced services.
- Include spatial ability, in addition to quantitative and verbal, as a talent area to be identified and cultivated.[5(a)]

- Encourage pre-service education and professional development for teachers and other personnel in recognizing and developing early signs of talent.[5(b)]
- Increase the federal government's national role in expanding opportunities for high quality out-of-class opportunities, including extended day and afterschool programs.[6]

Providing Opportunities for Excellence

Developing and supporting advanced knowledge and skills in K-12 requires that students have access to complex, challenging coursework taught by teachers who not only are well-prepared in the content area but also know how to support and inspire students. To improve our ability to meet the specialized needs of high-ability STEM students, we should:

- Increase access to gifted and talented programs and expand access to college coursework and other accelerated learning opportunities for students in high-need schools.[7]
- Create 1,000 new STEM-focused schools to excite and motivate students.[8]
- Recruit 100,000 great teachers who can prepare and inspire students.[9]
- Provide advanced courses that press students to set ambitious goals and achieve at higher levels[10]; pull-out programs in elementary and middle schools can give students who want to go beyond the standard curriculum a way to explore their interests.[11]

Removing Obstacles and Ensuring Supportive Practices

In many states and school districts, there are a host of administrative obstacles that prevent gifted and talented students from moving through school towards graduation at a pace faster than their age peers. Similarly, few districts have developed comprehensive policies that recognize gifted student learning differences and train key personnel and all classroom professionals to recognize, value, and respond to those differences so that gifted students can make learning gains commensurate with their abilities. To create school environments in which academic excellence is respected and can flourish, we should:

- Transform negative attitudes and mindsets of educators and students regarding abilities and intelligence.[12]
- Hold schools accountable for the performance of the top students, rewarding schools and districts that close the achievement gap at the high end of the learning spectrum.[13]
- Encourage state and local policies to adopt consistent and appropriate policies on curriculum acceleration and enrichment.[14]

We are long overdue in developing the systemic supports necessary to ensure a future generation that has the advanced knowledge and skills needed in the 21st century. Our continued inaction threatens the nation's future stability and prosperity.

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[1] Program for International Student Assessment (PISA), an international exam conducted every three years by the Organization for Economic Cooperation and Development for its 34 participating countries.
[2] Plucker, J. A., Burroughs, N., & Song, R. (2010). *Mind the (other) gap: The growing excellence gap in K-12 education,* p. 9. Bloomington: Indiana University, Center for Evaluation & Education Policy.
[3] Wyner, J., Bridgeland, J.M., & Diulio, J. J. (2008). *The achievement trap: How America is failing millions of high-achieving students from lower income families*, p. 15. Lansdowne, VA: Jack Kent Cooke Foundation.
[4] Wyner, et al., p 18.
[5 - 5(b)] NSB report, p. 21.
[6] President's Council of Advisors on Science and Technology (PCAST). (2010). *Prepare and inspire: K-12 education in science, technology, engineering, and math (STEM) for America's future*, p. 92. Washington, DC: Author.
[7] *A blueprint for reform: The reauthorization of the elementary and secondary education act.* (2010), pp. 25, 29. Washington, DC: U.S. Department of Education.
[8] PCAST report, p 101.
[9] PCAST report, p viii.
[10] PCAST report, p 87.
[11] PCAST report, p 94.
[12] NSB report, p 24.
[13] NSB report, p 24.
[14] NSB report, p 17.