

EDUCATION & COMPETITIVENESS

The Strengthening America's Future Initiative Issue Paper

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Education & Competitiveness

Summary

The Committee on Education and Competitiveness has focused on a number of issues in its meetings: setting rigorous common standards and assessments benchmarked internationally; increasing transparency and communication about the urgent need to improve education; strengthening the teacher corps for both current and future teachers; using technology to increase teacher and student productivity; and encouraging and preparing more students for STEM (science, technology, engineering, and mathematics) careers and citizenship decisions. It is imperative that the Obama Administration use the American Recovery and Reinvestment Act and Race to the Top funds to hold states and districts accountable for significant reforms in K-12 education. The Race to the Top proposals must be evaluated through a merit-based peer review involving educators who are able to identify proposals that can lead to transformative changes. Establishing a national laboratory in a small cadre of states with excellent plans for creating effective educational systems that move all students forward will achieve far more for the country than simply spreading funds across all states that apply.

Recommendation One: Improve Teacher Effectiveness

To develop and retain effective teachers, the United States must change its recruitment, preparation, professional development, compensation, and evaluation practices to reflect best practices of the highest-performing countries. The research is clear that the greatest determinant of students' academic achievement is teacher quality. It is absolutely essential to provide every child access to a highly effective teacher who can help that child achieve one or more years of academic growth for each year in school. Along with higher entry and exit standards for pre-service education, it will take a different compensation system and more professional working conditions to attract and retain effective teachers. Initial compensation must be competitive with the other options available to well-educated college graduates, and salary growth should be predicated on effective performance in the classroom. A new system of evaluation and continuous improvement is clearly as important for our teachers as it is for our students.

Recommendation Two: Use Technology to Raise Education Productivity, Innovation, and Achievement

Currently, education is one of the only sectors in which the introduction of technology has neither reduced costs nor added to productivity. Students seek innovative learning strategies in all subject areas, including the visual arts and graphic design that are key drivers of future success. In addition, technology can provide access to effective teachers in advanced courses or specialty areas for students in rural and inner-city schools. All teachers need access to technology tools for diagnostic purposes; for access to student files, student achievement data, and instructional resources; and for communication and collaboration with teachers and content experts from across the world. While technology cannot replace the important interactions between students and effective teachers, it can provide effective tools and options for expanding access to education excellence for all students, including students with disabilities and English language learners.

Recommendation Three: Increase the Pool of Students Pursuing STEM Careers

International competition requires that the United States support a vibrant STEM community producing breakthroughs and patents that maintain U.S. competitiveness. To accomplish this, students must have access to top-quality STEM education that is highly engaging and motivating, leads to higher order

thinking skills, and prepares them for civic engagement on STEM issues. In elementary through high schools, teachers must have a solid knowledge base in mathematics and science, continued professional development, and access to collaboration with colleagues and experts. The curriculum in STEM subjects should focus on fewer, clearer, and higher standards; practical applications of scientific and mathematical concepts; and engagement of students in “doing science” in functioning science labs.

Conclusion

Taking these steps would provide an enormous return on investment, not just for the young people affected, but for the economic and societal well-being of the United States as well. The quality of education of the next generation will be the determinant of our nation’s future success, and it is dependent upon the quality of our teachers. Recruiting and maintaining an effective teacher workforce requires changes in recruitment, selection, preparation, compensation, evaluation for continuous improvement, and working conditions. To improve the quality of education, technology must be a readily available tool in the hands of trained, effective educators. New systems of technology-based learning, web-based distance learning, and online professional development must be developed and made available to teachers and students across the country. This will take an investment in research and development that can spark increased educational opportunities for students previously left behind: students in rural and inner-city schools, gifted students without adequate resources, students with disabilities, and English language learners.

Finally, the United States must improve education in STEM areas for the vast majority of students who do not currently have access to effective teachers, engaging programs and curricula, and resources and facilities in which to “do” STEM rather than just read about it. With those prerequisites in place, the nation must provide resources to enable a growing number of students to learn about and pursue STEM careers at every level, from technician to research scientist. This will require an investment in scholarships, facilities, and resources at community colleges and four-year institutions of higher education. It will also require a change in attitude in the largely American notion that only the elite should be encouraged to pursue STEM careers. From elementary school through entry-level courses in colleges, students should be assisted and supported, not discouraged and discarded, in their pursuit of STEM careers.

With an education system that combines effective teaching, technological instructional resources, and opportunities to successfully pursue STEM careers, the United States will neither be out-taught nor out-competed in the global economy.

Introduction

“In a global economy where the most valuable skill you can sell is your knowledge, a good education is no longer just a pathway to opportunity—it is a pre-requisite. . . . The countries that out-teach us today will out-compete us tomorrow.”

—President Barack Obama, February 24, 2009

The Committee on Education and Competitiveness has focused on a number of issues in its first meetings: setting rigorous common standards and assessments benchmarked internationally; increasing transparency and communication about the urgent need to improve education; and strengthening the teacher corps for both current and future teachers. Over the past five months, the Obama Administration has focused on these issues as well as other related priorities. It has:

- Required states to provide assurances in four reform areas to receive \$48.6 billion in American Recovery and Reinvestment Act (ARRA) funds and be eligible for \$4 billion in Race to the Top funds:
 - College- and career-ready standards and high-quality, valid, and reliable assessments for all students, including English language learners and students with disabilities.
 - Teacher effectiveness and equitable distribution of effective teachers.
 - Data systems that connect Pre-K to K-12 to higher education and meet the principles in the America COMPETES Act.
 - Intensive support and effective interventions for the lowest-performing schools.
- Supported efforts of the Council of Chief State School Officers and the National Governors Association to establish a consortium of states committed to fewer, clearer, higher common standards and aligned, rigorous assessments in English and mathematics for K-12.
- Drafted state reporting metrics to ensure transparency and communication of the uses of ARRA funds in applications for the second round of State Fiscal Stabilization Funds.
- Announced the 2010 budget request, which includes \$517 million for the Teacher Incentive Fund, a program to develop comprehensive strategies for recruiting, preparing, rewarding, and retaining effective teachers.
- Established resource sites for three of the priority areas—effectively using data, improving teacher quality, and turning around low-performing schools—that include suggested uses of ARRA funds.
- Urged states to remove legislative or regulatory caps on the number of charter schools to encourage the development of additional effective charter schools for underserved students.

It is imperative that the Obama Administration use the ARRA and Race to the Top funds to hold states and districts accountable for significant reforms in K-12 education. The states’ Race to the Top proposals must be evaluated through a merit-based peer review involving educators who are able to identify proposals that can lead to transformative changes. Creating a national laboratory in a small cadre of states with excellent plans for creating effective educational systems that move all students forward will achieve far more for the country than simply spreading the funds across all states that apply. These well-funded plans will create models and systems that can be replicated in other states and will identify the practices and funding required to eliminate domestic ethnic or gender achievement gaps and to prepare all students for a productive life in a competitive global environment.

The establishment of internationally benchmarked common standards and rigorous assessments aligned to them is key to the improvement of education of children in all 50 states and the District of Columbia. It will provide the foundation for more effective teacher training and professional development as well as curriculum development aligned to the standards. These four components—effective standards, engaging and effective curriculum, rigorous assessments benchmarked internationally, and effective teacher professional development—constitute a coherent instructional system similar to those used in the highest-performing nations. Support from the federal government is essential for the development of

internationally benchmarked instructional systems with assessments moderated to international achievement standards. This addresses the foundation for improving the quality of teaching and learning in our schools. Having effective teachers in every classroom is crucial to the success of our students and the success of our nation.

This paper provides detailed recommendations required for ensuring the effectiveness of teachers, developing a pipeline for adding effective teachers to the system, using technology to raise productivity and innovation in education, and encouraging more young people to pursue STEM careers.

Recommendation One: Improve Teacher Effectiveness

To develop and retain effective teachers, the United States must change its compensation and evaluation practices to reflect best practices of the highest-performing countries. The research is clear that the greatest determinant of students' academic achievement is teacher quality. It is absolutely essential to provide every child access to a highly effective teacher who can help that student achieve one or more years of academic growth for each year in school.

The present compensation system is a disincentive to those currently teaching or considering education as a career as it generally¹ pays lower salaries than in other industries in return for receiving a generous defined benefit pension if a teacher remains in teaching in one state for at least 30 years. There is no differentiation in the single salary schedule used in most districts for teachers of shortage subject areas such as math and science, or for their willingness to teach in a low-performing or rural school, and certainly no additional compensation for teachers who are highly effective in raising student achievement levels. Teacher evaluation is usually based on one or two scheduled observations of the teacher done every one to three years, depending on the district, with less than 3 percent of the teachers in a district receiving unsatisfactory evaluations, even in low-achieving schools. Working conditions resemble factories more than professional workplaces, and, other than to leave the classroom, teachers have few opportunities to move up a career ladder.

Action One: Developing and Retaining Effective Teachers in the Current Workforce

Within **the next six months**, the Administration can address the following issues through reauthorization of the No Child Left Behind Act (NCLB), using funds already allocated to develop and retain effective teachers who are currently in the workforce:

- Changing the orientation and definitions from “highly qualified teacher” requirements in NCLB to “highly **effective** teacher” requirements to enable school districts to remove ineffective teachers.
- Requiring in the NCLB reauthorization the use of student performance data as one of the key measures in teacher evaluation and improvement efforts.
- Measuring whether teachers are both accountable and treated as professionals in their workplace with respect to opportunities for creativity, collaboration, professional development, and leadership.
- Requiring that the \$2.9 billion Improving Teacher Quality State Grants, Title II funds, be used solely to improve teacher and principal quality, and ensuring that they not be diverted for class-size reduction or other efforts not supported by research.
- Requiring new data system standards established by the Data Quality Campaign to include student and teacher identifiers to enable schools and school districts to link student and teacher performance.

In addition to NCLB and ESEA (Elementary and Secondary Education Act) reauthorization, the Administration **over the next six months** can advocate or even require the use of other authorized

grant funds as recommended below to improve the conditions for attracting and retaining effective teachers:

- Conducting large-scale evaluations through the Institute of Education Science and disseminating results on effective methods of teacher evaluation that accurately distinguish levels of teacher performance.
- Using the Teacher Incentive Fund to evaluate and fund new compensation designs offering greater differentiation in compensation, including incentives for hard-to-staff schools, shortage subject areas, individual effectiveness, **teacher team effectiveness**, and school-wide effectiveness, as well as establishing career levels with higher salary levels based on demonstrated knowledge and skills such as through standards-based evaluations, analysis of student achievement, and National Board Certification.
- Adding requirements for federal loan forgiveness programs to include nationally standardized and more rigorous criteria for entrance into teacher preparation programs and/or institutions, followed by evaluations of teacher performance and effectiveness in the classroom, with the degree of loan relief largely dependent upon the evaluations.
- Exploring tax incentives for businesses that support their employees' transition to teaching on a part-time basis as adjunct teachers or on a full-time basis for pending retirees.

Action Two: Ensuring an Ongoing Supply of Effective Teachers

In addition to general issues of teacher effectiveness, the United States must make adjustments in the pipeline for new teachers coming into the system. The first area to address is recruitment. Unlike Singapore and South Korea, the United States allows anyone who meets a college's teacher preparation entry requirements, usually a 2.5 grade point average, to prepare to be a teacher. This system results in full teacher education classes, but it provides no assurances to districts or schools that the graduates have been recruited from the top third, or even half, of entering college students, much less that they are likely to be effective teachers. In addition, it produces many more teachers than needed in certain content areas, such as physical education, and almost none in the needed areas of mathematics and science.

Not only does the current system allow, and even encourage, students in the bottom half of the class to become teachers, but it also means that the resources from the Pell Grant and loan forgiveness programs are incentives for them to select teaching. For example, the federal government offers up to \$17,000 in loan forgiveness to teachers of mathematics, science, and special education or up to \$5,000 to teachers of other subjects who teach for five consecutive years in low-income schools, regardless of their relative standing among entering college students or the quality of their preparation or effectiveness in the classroom. The compensation system described in the previous section provides virtually no incentives for students in the top quarter of the class or for career changers to enter or remain in the teaching profession. In addition, pension laws in some jurisdictions prevent highly qualified and richly experienced civil servants, business and civic leaders, or members of the military from maintaining the pensions earned in their first careers if they enter teaching as a second career. Their pensions are offset dollar for dollar by their teacher salary. Far worse, in most states, they are simply denied access to the educational system as teachers.

Over **the next six months**, the Administration can publicize efforts and requirements described in Action One to attract prospective teachers by:

- Encouraging the recruitment of students from the top third of their high school or college class by increasing compensation and providing incentives for effective teachers and those assuming additional responsibilities.
- Urging accreditation agencies to upgrade their criteria for excellence in teacher education programs.

Over **the next six months**, the Administration can work with the Office of Management and Budget to remove pension offsets for civil servants or military personnel willing to teach in K-12 schools.

By the **end of the current term**, the Administration can submit to Congress and urge passage of the following requirements in the reauthorization of the Higher Education Act:

- Strengthening the admission requirements for students entering colleges of education to ensure that candidates can demonstrate the strong cognitive abilities they must develop in their students.
- Engaging prospective candidates for teacher education programs in interviews with master teachers and principals to determine the fit between their personal qualities and the profession prior to entering teaching training programs. This is similar to what is done in Singapore.
- Connecting data on the effectiveness of graduates of teacher education programs to accreditation of those programs.

By the **end of the current term**, the Administration can identify sources of funds, such as savings from the student loan programs, for:

- Increasing federal funding, both tuition and salary stipends, for teacher training programs for career changers that allow them to study content pedagogy and observe effective practices prior to leaving their current jobs and entering classrooms, or that fund one-year, paid, teacher residency programs through the Robert Noyce Scholarship, Title II grants, the Math for America Program, or current Transition to Teaching and Troops to Teachers programs.

By the **end of the first term**, the Administration can provide incentives through the Teacher Incentive Fund grants to states to increase the attractiveness of the teaching profession to prospective teachers by:

- Changing pension systems for new teachers and for volunteers from the current teacher force from defined benefits to defined contribution programs that are portable across states or a combination of the two types. Note: This may be seen as a greater financial risk in the current economy, although the transition to defined contribution programs in higher education provides a positive example of the value of such a move.

Recommendation Two: Use Technology to Raise Education Productivity, Innovation, and Achievement

Currently, education is one of the only sectors in which the introduction of technology has neither reduced costs nor added to productivity. Students who are growing up as technology users are very frustrated by the lack of technology use in their classes. They seek innovative learning strategies in all subject areas, including the arts and design that are key drivers of future success. In addition, access to effective teachers in advanced courses or specialty areas is a challenge for students in rural and inner-city schools. A few options are emerging that enable teachers to use technology tools for diagnostic purposes, but they are not in broad use. Teachers in many districts do not have access to computers on a regular basis. Central offices in smaller and rural districts, as well as in many larger districts, lack the technology to provide teachers access to student files and student achievement data. While technology cannot replace the important interactions between students and effective teachers, it can provide effective tools and options for expanding access to education excellence for all students, including those with disabilities and English language learners.

With \$650 million for education technology in ARRA funding and an additional \$100 million in the 2010 budget, **the next six months** is the time to require states and districts receiving these funds to make effective uses of technology funds, such as:

- Providing access to distance learning or virtual courses in shortage or specialty areas where no qualified teacher is available or where it is more cost-effective to allow small numbers of

students to participate in effective virtual courses, offered in proven synchronous or asynchronous models.

- Providing online access to textbooks that are more up-to-date and less costly than classroom textbooks.
- Providing access to technology-based instructional learning systems that enable students to proceed at their own pace, especially in reading and mathematics and for students in alternative schools.
- Providing effective project-based learning options to students, using technology to access research and develop project documentation.
- Providing student access to web-based applications that enable them to communicate with and learn from other students across the classroom, school, nation and world or from scientists and scholars from across the world.
- Providing opportunities for students to research careers and identify career interests through use of Labor Department and nonprofit databases and interest inventories.
- Giving students and teachers access to open courseware from leading colleges and universities to learn and grow beyond what their school can offer.
- Ensuring that all teachers are trained to use and have regular access to web-enabled computer(s) in their classrooms for record keeping, lesson planning, professional development, networking with expert teachers and scholars, and creating activities that get more students engaged in learning.
- Providing teachers access to technology tools to diagnose student deficiencies and misconceptions and to design small-group instruction.
- Developing local, district, and state data systems that provide teachers and principals access to granular student achievement data and the ability to combine school-level diagnostic data with data reported at the district or state level.
- Developing technology tools that help automate student groupings, curriculum offerings, and teacher assignments to maximize the ability to target instruction to individual student needs at scale.
- Supporting research that identifies best practices in improving teaching that will emerge as more programs are launched.
- Developing and maintaining online student and teacher portfolios for assessment of student growth and teacher effectiveness.

Over the course of **the current term**, the Administration can identify funding sources within the federal budget (e.g., U.S. Department of Education, National Science Foundation) and foundation funding to establish a major research and development effort for:

- Developing, providing free or low-cost access to, and evaluating effective interactive computer simulations in mathematics, science, and social studies that enable students to develop knowledge and skills and better understand complex concepts.
- Developing online tools for creativity and performances in the arts and design.
- Developing and evaluating instructional resources in all subject areas that include unit plans aligned to standards and pre- and post-formative assessments of student learning in various formats, with evaluation rubrics that can be used to determine where students have developed competence and where they need further work. Electronic access would be available to teachers across the nation with credit given to teacher contributors.
- Creating and evaluating effective online teacher professional development programs with assessment of competence of teacher decision making through interactive simulations. These should be developed for teachers of elementary and secondary students in reading instruction in core subjects, mathematics, science, social studies, and fine arts.

Recommendation Three: Increase the Pool of Students Pursuing STEM Careers

The third recommendation area is increasing the number of students who are interested in pursuing careers in science, technology, engineering, and mathematics, or STEM, fields. International competition requires that the United States have a vibrant STEM community producing breakthroughs and patents that maintain U.S. competitiveness. Some observers have questioned whether a shortage is indeed looming, and the Bureau of Labor Statistics has admitted that it is not able to accurately predict needs in this sector. Given reports of low salaries for STEM professionals in other countries, students may do a cost-benefit analysis and determine that STEM careers other than medicine may not be a viable career option. Clearly, there is a shortage of STEM professionals in the national security sector, where projects cannot be outsourced to foreign workers in this country or to foreign countries.

Regardless of whether there is a STEM professional shortage, there is a crisis in the number of students who have access to high-quality STEM education that is highly engaging and motivating, leads to higher order thinking skills, and prepares students for civic engagement on STEM issues. In elementary and middle schools, few teachers have a solid knowledge base in mathematics or science. Nationally, at middle school, more than 40 percent of science teachers and more than 50 percent of math teachers have neither a major nor a minor in the subject they are teaching. The curriculum in STEM subjects is weak because of the breadth of standards to be covered and the focus is on imparting information rather than doing science. Despite fully accepted research findings as to the effectiveness of functioning science labs, most schools lack such labs. Worse, science assessments are too often fact- and vocabulary-driven, rather than including engagement of students in demonstrated practical applications. Such conditions discourage students from pursuing STEM careers, even though in a survey of more than 300,000 students, Speak Up 2007, 32 percent of U.S. middle school students and 38 percent of high school students indicated that they were somewhat or very interested in STEM jobs and careers.ⁱⁱ

Seven percent of students graduating from high school plan to pursue a STEM career, according to the biographical information on their SAT exam registration forms. Fewer than half of these students, however, make it through their first two years of college as STEM majors.ⁱⁱⁱ Reasons for this large dropout rate include large lecture classes, attitudes of many faculty members, and the quality of college teaching. Worse, many students simply are not adequately prepared for college STEM classes. The results can be devastating. Students who were interested in STEM and thought they were prepared discover that they do not have the rigorous background in math and science required for success in college courses. The 3 percent who are left may graduate with majors in STEM areas. After all these challenges, though, far too many of them are discouraged from going on to graduate school by the costs of continuing education and the opportunity costs of delaying entry into the workplace. Finally, the path to a Ph.D. has become extended to five years to seven, during which time students must subsist on a graduate assistant's stipend while friends in the private sector are moving up to six-figure salaries.

Over **the next six months**, the Administration can address the challenges of improving the quality of STEM education and encouraging more students to pursue and attain careers in STEM by:

- Implementing the effective teacher recommendations so that all students are taught by teachers with content knowledge and passion for their subject area.
- Supporting the development of new common science standards that are fewer in number, and are clearer, and higher, as well as effective curriculum and rigorous common assessments aligned to them, at an approximate cost of \$1 million (which could come from current NSF funding).

- Establishing guidelines for state use of the Improving Teacher Quality State Grants to focus on providing effective content-based professional development for current math and science teachers.
- Encouraging states to use ARRA school modernization funds to create or fix science labs in schools.
- Using Perkins national activities funding to offer competitive grants to states to expand STEM career programs among the career and technical education offerings at high schools and dual enrollment programs at community colleges. (This could be extended to encompass statutory guidelines for state Perkins funds during reauthorization in 2011.)
- Supporting the Department of Education and National Science Foundation Mathematics and Science Partnership programs as they collaborate on a single competition that enables both rigorous evaluations and replication of effective practices and that includes absolute and competitive priorities for states to:
 - Expand STEM options at schools and academies and recruit highly talented students to enroll in them.
 - Create partnerships among school districts, universities, museums and informal science centers, STEM professional groups, and local STEM companies that provide STEM mentors and role models to assist teachers, act as adjunct teachers, and engage students in projects, career investigations, and field trips
 - Recruit recipients of the Presidential Awards for Excellence in Mathematics and Science Teaching as coaches and mentors for teachers of math and science, especially at the elementary and middle school levels.
 - Establish out-of-school-time programs to engage elementary and middle school students in STEM activities with mentors and to provide STEM internship opportunities for high school students.
 - Identify and replicate effective programs to encourage underrepresented groups to prepare for and pursue STEM careers.
 - Expand programs such as UTeach that encourage STEM undergraduates to pursue teaching careers.
- Encouraging the key STEM mission agencies (DOE, NASA, DOD, NIH) to engage actively in local and national partnerships that take full advantage of their distinctive assets (workforce, research facilities, and missions) to engage teachers in applications of STEM and improve the quality of education provided to students.

By the **end of the current term**, the Administration can address the challenges of improving the quality of STEM education and encouraging more students to pursue and attain careers in STEM by:

- Creating a dialogue in higher education through the scientific and mathematic communities, the Business-Higher Education Forum and other partnership groups about:
 - Improving the culture and quality of teaching in entry-level STEM courses to increase retention of students in STEM majors.
- Providing additional funding from the Department of Education and the National Science Foundation to universities for:
 - Establishing STEM scholarship opportunities under the expanded Pell Grant program for students at two- and four-year institutions.*

* According to “Rising Above the Gathering Storm,” the cost of a USA-STEM program providing \$20,000 per year, four-year scholarships to 10,000 students annually would cost \$0.8 billion. The initial year would cost \$200 million and could be taken from the savings in privatizing the student loan program. The scholarships could range from \$10,000 to \$20,000, depending on whether the student plans to work in the private sector or commits to work for the federal

- government or teach in public schools for a prescribed period—two years for each year of funding.
- o Publicizing the opportunity and providing scholarships or loans to graduating students to pursue professional science or engineering degrees at the master’s level.*
 - * Using the calculations above, a two-year scholarship at \$20,000 per year for 10,000 students would cost \$400 million, \$200 million for the first year, and could be taken from the savings in deprivatizing the student loan program. The scholarships could range from \$10,000 to \$20,000, depending on whether the student plans to work in the private sector or commits to work for the federal government or teach in public schools for a prescribed period—two years for each year of funding
- o Providing undergraduate research opportunities to more STEM students.

Conclusion

Taking the steps recommended above would provide an enormous return on investment, not just for the young people affected, but for the economy and societal well-being of the United States as well. The quality of education of the next generation will be the determinant of our nation’s future success, and it is dependent upon the quality of our teachers. New teachers must be recruited from among the most talented young people and prepared to effectively teach students who come from a variety of backgrounds and circumstances. Current teachers who have not had the benefit of such education and training should receive it as a requirement and benefit of remaining in the profession. Along with education, a different compensation system and more professional working conditions will be necessary to attract and retain effective teachers. Initial compensation must be competitive with the other options available to well-educated college graduates, and salary growth should be predicated on effective performance in the classroom. A new system of evaluation and continuous improvement is clearly as important for teachers as it is for students.

To improve the quality of education, technology must be a readily available tool in the hands of trained, effective educators. New systems of technology-based learning, web-based distance learning, and online professional development must be developed and made available to teachers and students across the country. This will take an investment in research and development that can spark increased educational opportunities for students previously left behind: students in rural and inner-city schools, gifted students without adequate resources, students with disabilities, and English language learners.

Finally, the United States must improve education in STEM areas for the vast majority of students who do not currently have access to effective teachers, engaging programs and curricula, and resources and facilities in which to “do” STEM rather than just read about it. With those prerequisites in place, the nation must provide resources to enable a growing number of students to learn about and pursue STEM careers at every level, from technician to research scientist. This will require an investment in scholarships, facilities, and resources at community colleges and four-year institutions of higher education. It will also require a change in attitude in the largely American notion that only the elite should be encouraged to pursue STEM careers. From elementary school through entry-level courses in colleges, students should be assisted and supported in their pursuit of STEM careers, not discouraged and discarded.

With an education system that combines effective teaching, technological instructional resources, and opportunities to successfully pursue STEM careers, the ability of the United States to compete in the global economy will be second to none.

Appendix One: Effective Teacher Research

Using Value-Added Assessments to Support Better Teaching (Rivkin, Hanushek, and Kain, 2000)

Value-added studies underscore that some students experience less academic growth than would otherwise be expected simply because they are assigned to less effective classrooms and teachers. The question for policy makers is how to use value-added measurement to help improve overall levels of teaching and learning. A value-added assessment system can be a valuable tool for determining whether a school or system is making a difference in student learning, beyond family and community impact. Instead of just comparing districts or schools on end-of-year test scores, value-added assessments would compare them on gains in achievement. This comparison would help to statistically “level the playing field” among schools and districts with different populations of students by removing the substantial differences in student background. Although gain scores can depend on student characteristics, initial status is generally considered to have a greater impact on student improvement. Use of gain scores also would make results somewhat less susceptible to variation in a school’s population from one year to the next. Of course, sophisticated value-added assessments are only as good as their underlying tests. Annual student testing can be an imprecise gauge of whether teachers and schools are producing the desired results, partly because many tests currently in use are not aligned with state education standards (see American Educational Research Association, “Standards and Tests: Keeping Them Aligned,” *Research Points*, 1:1, spring 2003). Despite these limitations, value-added assessment is an improvement over simply comparing end-of-year achievement scores without controlling for what students knew at the beginning of the year.

Objectives of Teacher Incentive Schemes and Systems (Sclafani, 2009)

Educators and parents have long known intuitively that effective teachers are key to improving student achievement, and their intuition has been backed up by a number of research studies since 1990. Hanushek (1992) found that students whose teachers are at the top of the effectiveness range achieve as much as an additional year of growth in student learning over those with teachers near the bottom of the range, a gain of 1.5 years of academic growth as opposed to 0.5 years of growth in a single year. Sanders and Rivers (1996) used the large Tennessee student-testing database that linked teacher and student performance to identify teachers’ impact on student performance. They found that not only were there large differences between the effectiveness of different teachers, but also that the effects of those differences were both additive and cumulative: Given two similarly performing students in grade two, the difference in their performance three years later could be as much as 54 percentile points if one had three high-performing teachers while the other had three low-performing teachers. And their future performances continued to be affected by the quality of that early educational experience.

Rivkin et al. (2001) compared students of similar socioeconomic backgrounds and achievement levels and found that moving from an average teacher up one standard deviation to a teacher whose effectiveness was rated at the 85th percentile added four percentile points in student ranking, the equivalent effect of reducing class size by ten students or nearly 50 percent. Schacter and Thum (2004) went one step further and looked at the quality of teaching behaviors displayed by high-performing teachers. They found that teachers who scored well against the researchers’ evaluation rubrics representing 12 teaching performance standards produced much higher student performances than any other comprehensive school reform model tested. Teachers in their study produced a 0.91 standard deviation increase in student achievement, greater than the effect of parental income. Their work adds to the research by providing a model of teaching that can raise teacher performance and student achievement. The question then is how to attract, continue to develop, and retain teachers who are best able to take students to high levels of achievement.

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Appendix Two: Effective Teacher Preparation Programs

Hunter College, KIPP, Uncommon Schools, Achievement First Press Release

“In a path-breaking partnership between a school of education and three of the highest-performing urban charter school organizations, the Hunter College School of Education has joined forces with Achievement First, KIPP (Knowledge Is Power Program), and Uncommon Schools to collaboratively design a new teacher preparation program, which will lead to teacher certification and a master’s degree in education.

“To prepare our students to be effective teachers in the partnering charter public schools, the partnership is creating a new model of teacher training that is focused on and responsive to the needs of the students in inner-city public schools. The training will be unique in that [it] is being collaboratively designed and implemented by a college school of education and three urban charter school consortia. Faculty for the program are full-time faculty for the Hunter College School of Education, and experienced teachers and administrators [are drawn] from the partnership schools.

“Students in this program teach in their respective schools while taking courses leading toward a master’s degree in education. The courses and in-school clinical activities cover such areas as: classroom management, curriculum in the various subject areas, effective pedagogy for teaching these subjects, assessment of student learning, working with students with special needs—including English language learners—and working with parents and community organizations. During the program, students are closely monitored and supported through on-site visits by project faculty, videotaping of their teaching, and meetings with [project] faculty (both in person and through video-conferencing) to analyze these video records. We expect that students will attain master’s degrees and certification as teachers in New York State, as well as reciprocal certification in the other states represented in the partnership, after two years in the program.

“Rather than a conventional teacher preparation program in which course work represents discrete and often disconnected elements of information, theory, and practice, this preparation program is fully integrated with classroom teaching and will constantly spiral back, reinforce, and deepen critical classroom skills. Participants will present video portfolios of their teaching experiences in their schools, together with detailed self-analyses of those video case studies, in group discussions led by professors and master teachers from their schools.

“The program was launched in June 2007 as a pilot program with a cohort of 40 teachers drawn from all three of the partnership’s charter schools. Tuition for the teachers was secured through an Americorps

Professional Service Corps grant to the School of Education, and the Robin Hood Foundation generously provided the three charter school organizations with long-term support for the project through a major fundraising event.

“The first courses—“The Art and Science of Effective Teaching” and “Child Development”—were co-taught by four faculty (including department chairs) from the Hunter College School of Education, and three from the partnership schools, including Dave Levin, CEO of KIPP. All classes were videotaped for future reference and research purposes, and all the teachers enrolled in the program are now matriculated as Hunter College students. The course work of this first cohort is now continuing, drawing in some ten further faculty members from the School of Education and approximately the same number from the partner organizations, who are appointed as adjunct faculty at Hunter.

“In June of 2008 we welcomed our second cohort of approximately 100 teachers, drawn from both our original partner organizations and other New York City charter schools. Our strategic plan calls for the doubling again of the cohort that will enroll in the program in the summer of 2009.”

Available at: www.hunter.cuny.edu/school-of-education/special-programs-and-centers/teacher-you

The University of San Diego Masters Credential Cohort Program

This program is designed to prepare effective middle school and high school teachers. “The program focuses on the connection between theory and practice, weaving together university-based courses and field experiences. Candidates develop the knowledge, skills, and strategies needed to flourish in their own classrooms, as well as the critical habits of mind and reflective practice that will allow them to grow as educators throughout their careers.”^{iv}

Candidates can earn a degree in one year. The program uses an interdisciplinary approach on the humanities, languages, mathematics, and science. In addition, each candidate is prepared to teach a specific subject with course work in content area pedagogy. There are two semesters of student teaching assigned to effective teachers, with one semester at a middle school and the second semester at a high school. Candidates have opportunities to engage in action research and are required to engage in an international experience. Through the cohort model, candidates receive both personal attention and strong support from peers.

Endnotes

ⁱ The issue of comparisons of teacher pay to other professions is complicated by the differences in the lengths of work years—ten months vs. twelve months. The Bureau of Labor Statistics compares annual salaries because it cannot estimate the number of hours teachers dedicate to their work but recognizes that the hours go beyond official school hours of 8 a.m. to 3 p.m.

ⁱⁱ *Inspiring the Next Generation of Innovators: Students, Parents and Educators Speak Up about Science Education*, Project Tomorrow and PASCO Scientific, July 2008. Retrieved from www.tomorrow.org.

ⁱⁱⁱ *Post-Baccalaureate Experiences, Success, and Transitions*, Higher Education Research Institute, UCLA Graduate School of Education and Information Sciences. Retrieved from <http://heri.ucla.edu/nih/index.php>

^{iv} School of Leadership and Education Sciences Masters Credential Cohort Program. Retrieved from http://www.sandiego.edu/soles/programs/programs_offered.php.