

Comments on the notice of proposed priorities,
requirements, definitions, and selection criteria
for the Race to the Top Fund
(Docket No. ED-2009-OESE-0006 RIN 1810-AB07)

Association for Computing Machinery
Computer Science Teachers Association
Computing Research Association
National Center for Women & Information Technology

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Preface

We thank the Administration for the opportunity to comment on the proposed notice governing the Race to the Top Fund and for its commitment to improving the U.S. education system. The American Recovery and Reinvestment Act of 2009 (ARRA) sets in motion a historic opportunity to transform schools, strengthen teaching, and ultimately improve student learning and achievement. The Administration's notice clearly recognizes that the Race to the Top Fund is a crucial cornerstone for meeting these goals. We are particularly pleased to see that science, technology, engineering, and mathematics (STEM) education is a priority within the draft guidance and that it specifically calls for proposals that will increase the diversity of students taking STEM courses. Ethnicity and gender diversity is a significant challenge for computer science.

The final notice, however, should go further in addressing the challenges currently facing computer science at the K-12 level. It should ensure that resources can be dedicated to computer science education and not erect unintentional barriers to improving this subject area. Further, the final notice should place STEM education on equal footing with the required reform areas. We have offered several specific recommendations to address these issues.

Introduction

U.S. students are falling behind their peers on international assessments. This is particularly notable in STEM fields, where studies such as the Program for International Student Assessment and the Trends in International Mathematics and Science Study have shown the U.S. scores lagging behind international leaders in math and science. This is a significant concern, and we are particularly troubled by the state of computer science education in the United States.

It is often mistakenly assumed that computer science is part of the STEM education being offered in schools; however, as we have surveyed the educational landscape we have found that is not the case. Following the introduction of computer science into many high schools in the mid-1980's, there has been – over the past fifteen years – a significant dilution of what is called “computer science” at the high school level. As schools have increasingly stepped up the integration, use, and teaching information technology, the distinctions have blurred between these areas and computer science education. Educators consistently confuse the use of technology and teaching of technology literacy with teaching computer science as a core academic discipline within the STEM fields.

Because of this confusion, rigorous computer science is often given short shrift within the K-12 curriculum. In many cases, computing courses focus on basic skills – such as keyboarding or learning simple applications – instead of teaching students critical core computer science concepts¹ and problem solving. We want to ensure that rigorous computer science in K-12 is considered part of the STEM education priority. Our experience has been that we cannot simply assume that it is.

¹ For more information on what constitutes a rigorous computer science curriculum, see the four-part, grade-appropriate model curriculum the Association for Computing Machinery and the Computer Science Teachers Association have adopted at: <http://www.csta.acm.org/Curriculum/sub/ACMK12CSModel.html>

Education leaders want to ensure curriculum is preparing students with the knowledge and skills they need to succeed in the workforce or college. This intention is often squeezed by the limitations of the school day and fierce competition among subjects for inclusion. As education policymakers make tough decisions about which subjects will meet the needs of citizens, workers and industry in the 21st Century, they want to know how a subject makes students successful. Teaching computer science in K-12 meets students' needs in three ways:

- Students gain a deeper understanding of the fundamentals of computing, which is a critical foundational knowledge that will serve them well throughout their lives in an increasingly computerized future
- Students are exposed to a field that drives innovation and in which job prospects remain strong despite current extraordinary economic challenges
- Students gain critical knowledge and computational thinking skills proven to bolster their success in higher education academic pursuits

The ubiquitous nature of computing has spread its reach into everyone's daily lives. Securing our cyber-infrastructure, protecting national security, implementing electronic health records, and making our energy infrastructure more efficient are among numerous issues all dependent on computing. Computer science is the core discipline that underpins the sector responsible for creating the technology that is now central to our world – and growing more in importance every day.

Paradoxically, as the role and significance of computing has grown, the teaching of computer science in K-12 has faded. We find too few students have the opportunity to take engaging and rigorous computer science in high school². There is little ethnic and

² Growth in AP Computer Science tests taken has remain flat for the past decade while AP tests in other STEM fields has grown rapidly, see: <http://www.acm.org/public-policy/AP.jpg>

gender diversity among those that do³. Too few opportunities exist for professional development for teachers. Too little innovation has happened in creating an engaging and rigorous curricula for students. This is a national failing and one that we can ill afford as computing is now central to society and worldwide economic growth.

Summary of Recommendations

We make the following recommendations for the final notice. (These recommendations appear with discussion and justification in the following sections.)

- 1.A.** Add “computer science” after “study in ... mathematics, sciences,” to the Proposed Priority #2 (for STEM education) clarifying that a state application can support reform of existing computer science courses, introduce new rigorous computer science standards and courses, and support computer science teachers.
- 1.B.** Make Proposed Priority #2 (for STEM education) an absolute priority where a state application would have to describe how the state intends to improve STEM education (with appropriate selection criteria, minimum proposed evidence and proposed performance measures).
- 2.** Coupled with our recommendation (**1.B.**) add a new section (A)(4) containing selection criteria for subjects in STEM areas, including computer science, that may not be part of the “common set of K-12 standards” but are critical to ensuring student competitiveness in the 21st Century.
- 3.A.** Add an evaluation measure to the minimum proposed evidence (C)(1) “Providing alternative pathways for aspiring teachers and principals” that a state demonstrate

³ In 2008, only 17% of AP Computer Science test-takers were women even though women represented 55% of all AP test-takers, see: http://www.acm.org/public-policy/ap_women.jpg. Further, only 11% of AP Computer Science test-takers were minorities in 2008, see: <http://www.acm.org/public-policy/AP%20Science%20Minority%20.jpg>

to what extent its alternative certification program for STEM teachers, including computer science, draws upon nationally recognized models.

- 3.B.** Independent of the final notice, the Department should use federal funds to create a clearing-house of best practices for teacher certification in STEM fields that should facilitate the information sharing between states on effective certification and endorsement models.
- 4.** Add “computer science” after “... including mathematics, science” in section (C)(3) “Ensuring equitable distribution of effective teachers and principals.”
- 5.** Provide flexibility in the reporting requirements in section (C)(4) “Reporting the effectiveness of teacher and principal preparation programs” for new credentialing programs developed in areas where assessment data is limited, such as computer science.

1. Making Computer Science and STEM Education a Top Priority

The notice proposes a three-tier priority structure for Race to the Top funds. The first is an “absolute priority” where a state must show progress in the four education reform areas specified by ARRA: 1) implementing standards and assessments; 2) improving teacher effectiveness and achieving equity in teacher distribution; 3) improving collection and use of data; and, 4) supporting struggling schools. The second tier – “competitive preference priority” – places an emphasis on STEM education where a state will be awarded additional points of merit if one or more are included in the proposals. The third tier – “invitational priority” – contains three other categories, which are not the subject of these comments.

It is not clear that a state would be incentivized (or required) to improve computer science as part of a grant request even if the application contained proposals to reform STEM education. This is because of the current focus on “common standards” (see the

next section for detailed discussion) and because computer science is often not included as part of the STEM education curriculum in schools. As we noted in the introduction, because of the confusion around information technology literacy, computing across the curriculum and computer science it is not clear that simply stating STEM education in the notice means that state plans will include rigorous computer science education. We want to ensure that STEM education funding from the Race to the Top Fund is focused on improving computer science as an academic subject on par with mathematics, biology, physics and chemistry, not funneled toward courses that are simply teaching students basic information literacy skills (so called “point-and-click” learning).

Recommendation 1.A.: *Add “computer science” after “study in ... mathematics, sciences,” to the Proposed Priority #2 (for STEM education) clarifying that a state applications can support reform of existing computer science courses, introduce new rigorous computer science standards and courses, and support computer science teachers.*

Further, we appreciate the Administration included STEM education as a priority; however, placing STEM education in a secondary tier for Race to the Top funding puts it at a disadvantage relative to other priorities. This diminishes President Obama’s commitment to STEM education in his April 2009 comments to the National Academy of Sciences stating, “Since we know that the progress and prosperity of future generations will depend on what we do now to educate the next generation, today I’m announcing a renewed commitment to education in mathematics and science.” The Administration should alter The Race to the Top Fund to address this important goal.

It is critical that we take major strides toward improving STEM education. Today’s students will find themselves entering into a high-technology work environment where math and science knowledge will be fundamental for success. Global economic forces now shape the domestic workforce. Business can seek talent from around the world and

demand new innovations, fueled by technology, for success in a highly competitive global marketplace.

We recognize that some STEM education improvements will likely be included under the proposed selection criteria for the adoption of standards and assessments.

However, a state's proposal is unlikely to focus on STEM education as it seeks to fulfill the required "absolute priorities."

Recommendation 1.B.: *Make Proposed Priority #2 (for STEM education) an absolute priority where a state application would have to describe how the state intends to improve STEM education (with appropriate selection criteria, minimum proposed evidence and proposed performance measures).*

2. Common Core Standards and Computer Science

The notice places a clear priority on states using funding to implement a "common set of K-12 standards" accompanied by high-quality assessments. While the definition in the notice does not preclude other initiatives from meeting this requirement, it is widely understood that this means the ultimate adoption and implementation of the Common Core Standards Initiative currently being developed by the Council of Chief State School Officers and the National Governors Association.

We recognize that states working together toward a common set of standards is indeed historic, and it is appropriate that the Race to the Top Fund support this effort. However, the Common Core Standards Initiative will address only a narrow slice of the curriculum at the K-12 level, leaving other subject areas on the sideline for Race to the Top funding. By its own admission, the Common Core's initial focus will be on English language arts and mathematics standards, with plans to address science standards at an undetermined future date. We are deeply concerned that the focus on implementing the Common Core will leave computer science education at a disadvantage as states develop proposals for Race to the Top funding. This focus further exacerbates the

diminishing attention paid to science, computer science and other subjects in K-12 classrooms as a result of the requirements of the No Child Left Behind Act.

The previous section described how goals to put technology into the classrooms and teach technology literacy have confused what constitutes a rigorous computer science course. The push toward a set of common core standards further complicates this problem.

Much of what is called “computing education” by states at the K-12 level (particularly high school) is housed in “technology” education, both within the state standards and within the schools themselves. However, the curriculum of so-called computing classes within this category largely focuses on the use of technology (keyboarding, or learning word processing/spreadsheets), instead of core computing concepts. Very few states have a well-defined set of computer science learning standards.

As states move to require that students take four years of mathematics and four years of science as part of the core knowledge requirements, rigorous computer science is often not an eligible math or science credit. Currently, only ten states count upper-level computer science as either a math or science credit. In most cases, a computing course counts as a general elective credit.

Because computing standards often exist within technology standards and computer science courses, if they exist, count as elective credits, it is difficult to get rigorous computing courses into the college-bound academic curriculum. The core curriculum push could compound this problem as common mathematics and possibly science standards are formulated and implemented. While computer science should be a core component of STEM education in the United States, there is significant risk that computer science will be left out.

Recommendation 2: *Coupled with our recommendation (1.B.) add a new section (A)(4) containing selection criteria for subjects in STEM areas, including computer science,*

that may not be part of the “common set of K-12 standards” but are critical to ensuring student competitiveness in the 21st Century.

Alternative Certification of Teachers

Section (C)(1) of the notice “providing alternative pathways for aspiring teachers and principals” requires a state to describe the legal structure supporting certification of teachers and principals from non-traditional preparatory backgrounds. We welcome this provision because it could help draw more qualified computer science professionals into the field of teaching.

Computer science teacher certification is deeply flawed or non-existent in most states. The crisis in computer science teacher certification can be attributed to two key factors:

- a lack of clarity, understanding, and consistency with regard to current certification requirements
- where certification or endorsement requirements do exist, they often have no connection to computer science content.

It is absolutely essential that all computer science teachers, new and veteran, have adequate preparation to teach computer science successfully. It is equally important that we do not drive good, dedicated teachers who are already teaching computer science away from the discipline or even the classroom. The challenge for any model of teacher certification, therefore, is to find a way to deal fairly and respectfully with our existing teaching community, while at the same time ensuring that they are prepared to be the best computer science teachers they can be.

Although the populations from which we draw our computer science teachers are diverse (creating a wide continuum of expertise and experience), we believe that any preparation program for computer science teachers must include the following four major components:

1. Academic requirements in the field of computer science
2. Academic requirements in the field of education
3. Methodology (methods courses) and field experience
4. Assessment to document proficiency in general pedagogy, for example the Praxis II Principles of Learning and Teaching Test

The Computer Science Teachers Association recently completed a white paper on computer science teacher certification that provides a four-tier model with recommendations for: pre-service teacher candidates, teachers with no computer science teaching experience, teachers with computer science teaching experience, and individuals transitioning from business with a computer science background.⁴

Recommendation 3.A.: *Add an evaluation measure to the minimum proposed evidence (C)(1) “Providing alternative pathways for aspiring teachers and principals” that a state demonstrate to what extent its alternative certification program for STEM teachers, including computer science, draws upon nationally recognized models.*

Recommendation 3.B.: *Independent of the final notice, the Department should use federal funds to create a clearing-house of best practices for teacher certification in STEM fields that should facilitate the information sharing between states on effective certification and endorsement models.*

⁴ The models can be found on pages 12-15 on the following report: <http://www.csta.acm.org/ComputerScienceTeacherCertification/sub/TeacherCertificationRequi.html>

4. High Need Subjects

Section (C)(3) of the notice, “Ensuring equitable distribution of effective teachers and principals,” proposes as a selection criteria “to increase the number and percentage of effective teachers (as defined in this notice) teaching hard-to-staff subjects including mathematics, science, special education, English language proficiency, and other hard-to-staff subjects identified by the State or LEA.” By listing several subject areas, the draft notice identifies a set of areas where there are clearly needs. Because the job market for computer science majors is strong, starting salaries are high⁵ and (as we noted in the previous section) computer science teacher certification is flawed or absent in many states, computer science teachers meet the hard-to-staff subject criteria and should be listed in this section.

Recommendation 4: Add “computer science” after “... including mathematics, science” in section (C)(3) “Ensuring equitable distribution of effective teachers and principals.”

5. Potential Barriers to New Teacher Preparation Programs

Section (C)(4) “Reporting the effectiveness of teacher and principal preparation programs” requires states to link student performance coupled with teacher and principal performance data to credentialing programs. These reports would be made public, thus ensuring greater transparency of the efficacy of credentialing programs. We expect these reports would continue long after Race to the Top funding was exhausted; therefore the notice should consider the long-term ramifications of this provision.

There are few computer science teacher preparation programs in the United States, and those that do exist are exceedingly small. Creating new programs is an important goal

⁵ According to the *Summer 2009 Salary Survey* by the National Association of Colleges and Employers, “engineering disciplines account for four of the five disciplines getting the highest starting salary offers” for bachelors degree candidates, with computer engineering and computer science coming in at fourth (\$61,738) and fifth (\$61,407) on the list respectively, see: <http://www.nacweb.org/press/display.asp?year=2009&prid=304>

for the computing community, particularly as the College Board and the National Science Foundation work toward reforming the Advance Placement Computer Science course⁶. As new programs become established, student performance data may lag behind programs with more experience. Because the provision would require programs over the size of twenty graduates to report public data on performance, colleges and universities may shy away from starting new programs that are not guaranteed to perform well. As a result, this provision could have the unintended consequence of hurting efforts to establish much-needed computer science methodology courses and credentialing programs.

Recommendation 5: *Provide flexibility on the reporting requirements in section (C)(4) “Reporting the effectiveness of teacher and principal preparation programs” for new credentialing programs developed in areas where assessment data is limited, such as computer science.*

About the Respondents

With over 90,000 members worldwide, the Association for Computing Machinery is the world’s largest educational and scientific computing society, uniting computing educators, researchers and professionals to inspire dialogue, share resources and address the field’s challenges. ACM strengthens the computing profession’s collective voice through strong leadership, promotion of the highest standards, and recognition of technical excellence. ACM supports the professional growth of its members by providing opportunities for life-long learning, career development, and professional networking.

The Computer Science Teachers Association is a professional membership organization committed to supporting the teaching and learning of computer science in K-12. Formed in 2005, it now encompasses more than 7,300 members, primarily practitioners

⁶ It is envisioned that the new course, AP Computer Science: Principles, will require substantial new resources to retrain existing and recruit new computer science teachers. For more information on the effort see: <http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=0938336>

teaching in K-12. CSTA is a national leader in the conduct of academic research and the provision of professional development for teachers and the distribution of teaching, learning, and informational resources focused on computer science.

The Computing Research Association is an association of more than 200 North American academic departments of computer science, computer engineering, and related fields; laboratories and centers in industry, government, and academia engaging in basic computing research; and affiliated professional societies. CRA's mission is to strengthen research and advanced education in the computing fields, expand opportunities for women and minorities, and improve public and policy maker understanding of the criticality of computing research in our society.

The National Center for Women & Information Technology is a non-profit coalition working to improve U.S. innovation, competitiveness, and workforce sustainability by increasing women's participation in IT. NCWIT's work spans K-12 and higher education through industry and academic careers. NCWIT has over 180 industrial, non-profit and higher education members from a wide variety of fields.