Computing in K-12 STEM Education
Critical for 21st Century Skills

The Association for Computing Machinery (ACM) strongly supports the President Elect's stated goal that science and mathematics education should be a national priority in K-12. We stand ready to help the Administration meet this goal. We believe that computer science education should be an integral part of our education system and wish to work with the new Administration during the transition period to ensure that the computing field's voice is heard as it sets its initial policy priorities.

Background

ACM is committed to strengthening and improving computing education across the entire educational pipeline. Like many other scientific societies we strongly support efforts to increase the participation in and retention of students in STEM (Science, Technology, Engineering and Mathematics) fields. ACM's focus is on computer science education, which faces special challenges, particularly at the K-12 level.

The outlook for computer science-related jobs remains strong despite the extraordinary economic challenges we face. Computer science underpins the technology sector, which has made tremendous contributions to the domestic economy, as well as numerous other sectors that depend on innovative, highly skilled computer science graduates. The ubiquitous nature of computing has spread its reach into everyone's daily lives. Securing our cyber-infrastructure, protecting national security, and making our energy infrastructure more efficient are among numerous issues all depending on computing. However, with the percentage of undergraduates majoring in computer science and interest at the K-12 level falling, the pipeline supplying the necessary workforce is shrinking.

Today's students are required to make decisions about their educational and career pathways often as early as middle school. Studying computer science in K-12 alerts them to the fact that computer science is an exciting educational discipline and provides a pathway to a rich array of careers. Computer science also provides an important skill set for students entering any career area, including other sciences where innovation and breakthroughs increasingly depend on the contributed knowledge of computer scientists.

A fundamental understanding of computation and computational or algorithmic thinking is increasingly important to success in the digital age. Computing education will benefit all students, not just those interested in pursuing computer science or information technology careers. Computer science develops and extends logical thinking and problem-solving skills. Students who participate in high school computing classes and have previous experience with technology demonstrate improved readiness for post-secondary studies.

Issues

While computing education opens many doors, students often do not have many opportunities to engage in rigorous study of computer science. Among the many challenges at the K-12 level are:

- Courses in the fundamentals of computer science often count only as a general elective, not as a college-preparatory elective, at the secondary level. Given the demands on college-bound high school students, it is unlikely that these students can afford to explore computer science.

- As schools have increasingly stepped up the need to integrate, use, and teach information technology, the distinctions have blurred between what is called computer science and what is, in fact, information technology literacy and the use of technology to support learning.

- Certification requirements for high school computer science teachers vary from state to state. In some cases, no computer science certification is available and computer science teachers must be certified in some other additional discipline; in others, teachers are required to demonstrate knowledge in some discipline other than computer science (for example business or technical applications) to teach computing courses.

- Because of the confusion between computer science and technology education, lack of certification standards, and the narrow focus by policy-makers on core courses tested under the No Child Left Behind Act, professional development programs for computer science teachers and research initiatives in computer science education have lagged behind other fields.

- Participation rates by women and minorities in computer science are among the lowest of any scientific field. In 2008, only 17% of AP computer science test-takers were women, even though women represented 55% of all AP test-takers. Participation in computer science AP tests among underrepresented minorities has increased in the past 10 years but is only at 11%, compared to 19% of all AP test-takers.

Recommendations

Addressing these issues requires action from federal, state and local policy makers as well as from the high-tech industry and scientific and education societies. As such, ACM welcomes the Administration's proposals on STEM education, particularly recruiting new STEM teachers to high-need school districts, expanding professional development opportunities and education research resources, focusing on middle school student achievement, closing the achievement gap, and increasing participation in AP classes.

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The Administration can play an important role in clarifying that computer science should be a central part of any STEM education initiative and recognizing the importance of a rigorous computer science education. We wish to work with the Administration on initiatives to address key issues that computer science education faces and make the following initial recommendations:

- Consider computer science as one of the core courses students need to develop critical 21st Century skills as part of any STEM education initiative.

- Because research indicates that middle school curriculum is very influential in determining childrens' future interests, any efforts to strengthen middle school education should include provisions to introduce these students to computer science. Several new approaches in computer science education show promise in attracting and holding the attention of middle school children.

- Expand efforts to increase the number of females and underrepresented minorities in this field.

- Clarify and expand the professional development opportunities for high school computer science teachers. This will improve classroom instruction and student achievement, particularly in block grant programs given to states.

- Focus research funding on K-12 computer science education to address many gaps in understanding how students engage this critical field.

- Review how states can better coordinate, clarify and improve existing teacher certification requirements, particularly for computer science teachers.

About ACM

ACM, the Association for Computing Machinery, www.acm.org, 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.

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