Connecting K-12 Teachers to STEM Careers through Industry Collaboration

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Abstract

Classroom to Careers - Applied Computational Thinking in Middle Schools, or C2C, is an NSF grant that was submitted in April 2012 to connect STEM teachers to careers. The belief of the researchers is that kids would be more engaged and excited about Math or Science if they understood careers that aligned with the problems they are solving. The proposal developed a team comprised of researchers, industry and 7th–9th grade educators; and included technologists and career specialists who recognized the need to tackle these challenges and committed to working together to advance computational competencies in middle school students. C2C was developed to address the issue of teaching computational literacy by a focused effort to expand those skills. The model used was to educate a team of 7th-9th grade teachers and their students in a tri-state area. The teams would increase the understanding and use of several modules—including applications, tools, technologies, career information, visualizations, curriculum, lesson plans, and objectives for lesson plans—that would be carefully researched and selected for their relevance and usefulness. This paper outlines the C2C concept and demonstrates the alignment with industry to expand STEM education and careers.

Introduction and background

The Commission on Professionals in Science and Technology\(^1\) that U.S. STEM workforce needs to continue to grow and yet there is a significant deficit in the “supply side” of the STEM workforce due to lack of interest in these areas. Workforce shortages in STEM fields have been described in numerous other reports, including those by the NAS\(^2\), National Academy of Engineering\(^3\), National Science Board\(^4\) and President’s Council of Advisors on Science and Technology\(^5\). The national workforce shortage in STEM is the result of many factors, including an individual’s confidence in choosing a career path.

This confidence in choosing a career path is impacted by personal interest\(^6,7\), relevance, awareness, and self-efficacy. Self-efficacy is described as “people’s beliefs about their capabilities to produce effects,” including results and understanding. Self-efficacy increases through modeling the successful behavior of others and through mastery experiences\(^7,8\). Furthermore, it has been shown that external influences and experiences, including instructional practices and academic experiences, can positively impact STEM career awareness, self-efficacy, and engagement\(^9,10,11\).
A student’s choice to pursue STEM careers is also impacted by an awareness of career opportunities. Dorssen, Carlson, and Goodyear reported that students in general have a limited understanding of available careers and requirements for success. In examining informal and formal education, they found that several factors that influence decisions to pursue STEM careers, including: academic preparation and achievement; identification with STEM careers; self-efficacy; and motivation, interest and enjoyment. There is also an important need for teachers to understand the range of career opportunities in STEM, so they can share those opportunities with their students and inspire them to succeed. Hall, et al., 2011 reported that school personnel having limited knowledge of STEM careers; “of special concern” from the student perspective is the “limited knowledge of science and math teachers and counselors with respect to STEM careers.”

Partners for the grant

The development of this grant was formulated by three college professors from different Technology related majors who are women in male dominated technical fields. They partnered with three schools to propose developing a team of master teachers in the public schools. Table 1 shows some of the student demographics from the three schools that agreed to partner on the proposal.

Table 1. 7th – 9th grade school partners

<table>
<thead>
<tr>
<th>State</th>
<th>Demographics</th>
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<tbody>
<tr>
<td>Indiana</td>
<td>62% White, 12% Black, 19% Hispanic</td>
</tr>
<tr>
<td>Michigan</td>
<td>34% White, 60% Black, 4% Hispanic</td>
</tr>
<tr>
<td>Illinois</td>
<td>47% White, 43% Black, 2% Hispanic</td>
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Other partners include academic groups to be used for references, feedback, and dissemination. These include, but are not limited to:

- American Society for Engineering Education
- Associated Schools of Construction
- Association of Career and Technical Educators (national and regional)
- Conference for Industry and Education Collaboration
- National Science Teachers Association
- Michigan Association of Science Teachers
- Illinois Association of Science Teachers.
Partners from industry that have agreed verbally or in writing to be advisory board members include, but are not limited to:

- Mechanical Contractors Association of America
- National Association for Workforce Improvement
- Women in Aviation
- Victaulic Corporation
- National Association of Women in Construction
- Construction Advisory Board at xxxx university.

Through the instruction by the teachers and the use of the C2C modules, problem solving skills can be taught to 7th through 9th grade students in ways that show alignment with careers. It is important that all students have the opportunity to develop the skills to gain confidence and embrace new ways of solving problems. This is particularly true of students from groups who have been underrepresented in careers in science, technology, engineering, and mathematics (STEM). Often these students are not given the opportunities, lack the confidence or are discouraged in doing so due to a lack of resources, role models, or the ability to envision careers in STEM [14, 15, 16, 17].

Project Summary

The mission of C2C is to increase the competence and confidence of 7th-9th grade educators and by building classroom modules that align existing course materials to STEM career options. These course materials make use of applications, innovative technologies and visualization tools. The 7th-9th grade level is an opportune time to impact the perceptions of students. By appealing to real-world societal needs, the students will gain insight about a range of STEM career opportunities. Aviation, construction, and information technology have been selected as the disciplines which will be targeted due to the need to add to these areas.

The goals of C2C’s work are to evaluate the modules for their effectiveness, disseminate successful modules, and to address research questions related to an increase in teacher’s confidence and competence in teaching, student's understanding and confidence in pursuing STEM careers, applications and tools best suited for middle schools, and the recruitment and retention of underrepresented students in STEM.

Conclusions

The goals of these authors are to spread the word of the possible ways to connect to industry and train teachers. This format, in the researchers’ views, is working toward recruiting students into areas of need for the STEM workforce. This may be accomplished by appropriately teaming the industry professionals who understand the actual career paths with educators. As K-12 students understand possible career paths, they can make more informed decisions about college majors. The college professors’ work to understand not only the K-12 teachers and how they can be given better resources to prepare kids, but also how to better prepare college students for careers. This is a win-win for all of the collaborators to build a program which help connect young adults into careers of their dreams.
Bibliography

6. President’s Council of Advisors on Science and Technology; Report to the President; Prepare and Inspire: K-14 Education in Science, Technology, Engineering and Math (STEM) for America’s Future; September 2010.

Biographical Information

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