



STEM (Science Technology Engineering Math) Education & Service-Learning

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STEM is an acronym for Science, Technology, Engineering, and Mathematics and usually refers to education in one or more of these disciplines. There has been a concern over the past several years of a decline in STEM education in the United States. In the new global economy an education with a STEM focus is a vital step towards providing citizens with the needed skills and technological familiarity that will enable them to take part in the exciting economies of the future. This is also a fertile area where service-learning can flourish and help bring the broadest array of students as possible into the modern workforce. There is a concerted effort by our nation's educators to encourage STEM studies that will enable students to actively engage in the knowledge-economy and to give many more youth from disadvantaged circumstances STEM service-learning opportunities. Educators are also seeking to promote STEM study by America's students, especially those from underrepresented groups, including minority, women, and disadvantaged students. Successful STEM service-learning programs will be those that seek out these communities and should provide student participants with the opportunity to:

- Use the knowledge and skills of one or more STEM discipline(s) to identify and address community problems;
- Collaborate with peers and community members to set and achieve goals; and
- Develop skills and attitudes useful for the workplace and for participating in civic affairs.

Three organizations that will use service-learning to ignite the passion for math and science in thousands of low-income students, thanks to grants from **Learn and Serve America's STEM Initiative**:

University of Alabama, Tuscaloosa, AL

Will receive a grant to establish a Science in Action program that will create Professional Learning Communities for teachers in Alabama and Georgia to help them use service-learning to advance science achievement.

Earth Force, Inc., Denver, CO

Will use their grant to undertake a Watershed STEM Initiative to expand and institutionalize the Global Rivers Environmental Education Network program in seven school districts. Working with universities and other resource partners, local school districts will train educators, provide on-going technical assistance to individual teachers, and help schools form lasting collaborations with watershed associations.

The American Forest Foundation, Washington, DC,

Will receive a grant to infuse service-learning into Project Learning Tree, its well-respected, widely used environmental educational curriculum. In four regions of the country, the foundation will offer training to teams of teachers, helping them engage their students in action projects that address environmental issues.

Below is a list highlighting STEM organizations and resources, including models and research:

General STEM Resources

Journal of STEM Education

The Journal of STEM Education: Innovations and Research is a half yearly, peer-reviewed publication for educators in Science, Technology, Engineering, and Mathematics (STEM) education. The journal emphasizes real-world case studies that focus on issues that are relevant and important to STEM practitioners. These studies may showcase field research as well as secondary-sourced cases. The journal encourages case studies that cut across the different STEM areas and that cover non-technical issues such as finance, cost, management, risk, safety, etc. Case studies are typically framed around problems and issues facing a decision maker in an organization.

www.auburn.edu/research/litee/jstem/index.php

STEM Education Caucus

Maintained by the National Science Teachers Association, the STEM ED Caucus seeks to strengthen STEM education at all levels (K-12, higher education and workforce) by providing a forum for Congress and the science, education and business communities to discuss challenges, problems, and solutions related to STEM education. Includes links to related STEM resources and information.

www.stemedcaucus.org

STEM Education Coalition

The Science, Technology, Engineering, and Mathematics (STEM) Education Coalition works to support STEM programs for teachers and students at the U. S. Department of Education, the National Science Foundation, and other agencies that offer STEM related programs. Find resources, reports, and legislation on STEM education or join the Coalition.

www.stemedcoalition.org

College of Menominee Nation STEM Curriculum Enhancement Project

This page describes a National Science Foundation Award winning Tribal STEM project.

www.sciencestorm.com/award/0323742.html

CRS Report for Congress: Science, Technology, Engineering, and Mathematics (STEM) Education: Background, Federal Policy, and Legislative Action

This report provides the background and context to understand these legislative developments. The report first presents data on the state of STEM education in the United States. It then examines the federal role in promoting STEM education. The report concludes with a discussion of the legislative actions recently taken to address federal STEM education policy.

www.fas.org/sgp/crs/misc/RL33434.pdf

Ritter-Smith, Kathryn. *When Community Enters the Equation: Enhancing Science, Mathematics, and Engineering Education through Service-Learning*. Providence, RI: Campus Compact, 1998.

The anthology includes the following essays related to service learning in the hard sciences: "Why Service-Learning? And How to Integrate it into a Course in Engineering," Edmund Tsang; "Enhancing our Courses: New Dimensions Through Service-Learning," (mathematics), Joan Kleinman; "Reflection in Science Courses: Is it Feasible?," (chemistry), Deborah Wiegand; "Professional Activism: Building Service-

Learning, Reconnecting Community, Campus and Alumni Through Acts of Service," (civil engineering), Rand Decker; and "Forgiving Effective Service-Learning Partnerships via the Cascade Model," (biology and health education), Amal Abu-Shakra and Tun Kyaw Nyein. servicelearning.org/library/lib_cat/index.php?library_id=3446

Electric Industries Alliance. Chapter 5: Policy Recommendations: K-12 Science, Technology, Engineering and Math (STEM) Education. In *The Technology Industry at an Innovation Crossroads*. Electronic Industries Alliance, 2004. eia.org/docs/innovation_playbook.pdf

Curriculum Resources

Service-Learning Ideas & Curricular Examples (SLICE)
www.servicelearning.org/slice

Campus Compact Service-Learning Syllabi
www.compact.org/syllabi/

STEM Service-Learning Research & Resources

Science

Chemistry & Service-Learning in Higher Education
servicelearning.org/instant_info/fact_sheets/he_facts/chem_he/index.php

Campus Compact. *Science and Society: Redefining the Relationship*. Providence, RI: Campus Compact, 1996.

In an attempt to provide instructive models of the design and implementation processes commonly associated with service-learning courses, this publication maps the development of 18 service-learning course in the SEAMS (Science, Engineering, Architecture, Mathematics, Computer Science) disciplines at the high school and college levels. servicelearning.org/library/lib_cat/index.php?library_id=489

Haines, Sarah. Informal Life Science: Incorporating Service Learning Components Into Biology Education. *Journal of College Science Teaching*, v.32(7), 2003, 440-442. In a course designed for students pursuing science careers in informal educational settings, students received training in environmental education programs and applied their training at a local nature center to fulfill the course's service learning requirements. Both university students and school children alike benefitted from this partnership. servicelearning.org/library/lib_cat/index.php?library_id=5684

Little, Nan. *Science Service Learning Student Manual*. Seattle, WA: University of Washington, 1996.

A compendium of articles, project and program descriptions, curriculum descriptions, and contact information on the subject of science service learning. This manual is intended to provide the rationale of science service learning as well as detailed information to help integrate and replicate science service learning projects. (AT) servicelearning.org/library/lib_cat/index.php?library_id=2939

Ramey-Gasserrt, Linda. Learning Science Beyond the Classroom. *The Elementary School Journal*, v.97(4), 1997, p433.

Science education reform documents call for science to be taught in the manner that students learn best, by conducting hands-on, engaging investigations using simple everyday materials. Often overlooked in the redesign of science education, informal science learning environments such as science centers, museums, and zoos provide students with captivating science experiences that can be related closely to curricular objectives. In this article I examine a cross-section of craft knowledge and research-based literature on science learning beyond the classroom, describe informal science education programs, and discuss implications for enhanced science teaching. The article focuses on the importance of informal science learning experiences, in the context of a variety of out-of-school science environments, for children and for in-service and preservice teachers. Informal science education environments provide students with unique, engaging science learning opportunities and classroom teachers with a wealth of science teaching resources. A model for enhanced school/informal science education and for school-level policy change is proposed.

servicelearning.org/library/lib_cat/index.php?library_id=3388

Wozniak, Jacci. *Mathematics and Science Faculty Service Learning Handbook*. Los Angeles, CA: ERIC Clearinghouse for Community Colleges, 1996.

Resources developed by "Campus Compact," a coalition of over 550 colleges and universities established to create and enhance service-learning opportunities for students, are presented in this handbook for mathematics and science faculty. A brief introduction defines service-learning and provides a continuum of types of service-learning, such as one-day fundraising tasks, class-related assignments, volunteer tutoring, and paid internships. The first section provides sample documents used in administering programs, including a development form for integrating service-learning into a course, a reasoning objectives matrix, a student application, a learning hour report, and an evaluation form. The next section underscores the importance of reflection in the service-learning process, offering models and guidelines for facilitating reflection among participants. Selected resources are provided in the following section, and a sample analysis of the effects of tutoring on academic achievement. The final section contains sample syllabi designed to assist instructors who wish to integrate a service learning component into their math and science courses. servicelearning.org/library/lib_cat/index.php?library_id=4028

Technology

Folkestad, James E., et al. The Implications of Service-Learning for Technology Studies. *Journal of Technology Studies*, v.28(1) Winter-Spring 2002: p52-58.

A "toys for tots" service-learning experience integrated into an industrial technology management course required development and planning using a process planning and costing model and work with a variety of stakeholders including an Even-Start learning center. Challenges include the lack of service-learning precedent in technology studies and the nature of the reflection component.

International Society for Technology in Education

The International Society for Technology in Education (ISTE) is a source for professional development, knowledge generation, advocacy, and leadership for innovation. From their website you can find K-12 educator resources, including books, journals, and toolkits.

www.iste.org/

Leh, Amy S. C. Lessons Learned from Service Learning and Reverse Mentoring in Faculty Development: A Case Study in Technology Training. *Journal of Technology and Teacher Education*, v.13(1), 2005, 25-41.

This article introduces technology training designed for university professors who work with preservice and emergency teachers at a College of Education of a state university. The technology training was delivered in multiple ways: (a) large group workshops, (b) small group meetings, (c) individual mentoring, and (d) just-in-time training. Service-learning and reverse mentoring were the highlights of the project; they were used in individual training during which graduate students in the Instructional Technology (IT) program served as mentors to the university professors. Formative evaluation was conducted, and the results were positive. Such training worked well in this Teacher Education program and may benefit other higher education institutions or K-12 schools.

servicelearning.org/library/lib_cat/index.php?library_id=6721

Shulman, S., et al. Service-Learning and the Digital Divide.

This paper reports on an ongoing National Science Foundation (NSF) grant enabling two central Iowa institutions of higher education, Drake University and Iowa State University, to assess the efficacy of service-learning interventions in the dissemination of Information Technology Literacy (ITL).

servicelearning.org/library/lib_cat/index.php?library_id=6306

Wisconsin Department of Public Instruction. *Youth Connecting Communities: From Digital Divide to Digital Opportunity*. Madison, WI: Wisconsin DPI, 2004.

More than 40 percent of Wisconsin's students attend schools in rural communities. Many rural schools face unique challenges, often related to economic need, when planning for the future. The digital divide grant received from the Corporation for National and Community Service offered rural communities a new opportunity to address persistent difficulties. The grant equipped hundreds of young rural leaders with leadership skills and entrepreneurial and technology training. The young people then shared their new skills with their schools and communities, initiating projects to bridge the digital divide. This publication describes the programs developed by the 14 participating districts and the impacts each project made. Some examples are a middle school class that taught a weekly computer class to senior citizens at a local retirement center. Students in a school district received training to become community technology consultants. As part of a 3-year project, they then developed a village website.

servicelearning.org/library/lib_cat/index.php?library_id=6328

Engineering

Engineering Education & Service-Learning

servicelearning.org/instant_info/fact_sheets/he_facts/eng_ed/index.php?indexAll

EPICS – Engineering Projects in Community Service

EPICS is a unique program in which teams of undergraduates are designing, building, and deploying real systems to solve engineering-based problems for local community service and education organizations. epics.ecn.purdue.edu/

Tsang, Edmund, and Edward Zlotkowski. *Projects that Matter: Concepts and Models for Service Learning in Engineering*. Herndon, VA: Stylus, 2000.

The purpose of this monograph is not only to serve as a practical guide for faculty seeking to integrate service-learning into an engineering course but also to examine larger issues of engineering education, the mission of higher education, and the role of service-learning as a catalysis for program reform and educational enhancement.

servicelearning.org/library/lib_cat/index.php?library_id=3863

University of Washington. *Case Studies in Community-University Partnerships: Department of Computer Science and Engineering*. Seattle, WA: UW, 2004.

This case study documents a number of partnerships undertaken by the Computer Science and Engineering department at the University of Washington, some within the bounds of the university, and many of them extending beyond the UW campus.

servicelearning.org/library/lib_cat/index.php?library_id=6187

Mathematics

Math & Service-Learning in Higher Education

servicelearning.org/instant_info/fact_sheets/he_facts/math_he/index.php

Allen, Jo Anna. Eureka! A Yurt! Integrating Mathematics, Cooperative Learning and Community Service. *Journal of Experiential Education*, v.14(3), November 1991, p39-44. A sixth grade class built a yurt (a circular building with a cone-like roof) for the playground of a special education school. The goals of the project were to teach mathematics experientially and to facilitate growth through community service. Includes instructions and diagrams for building yurts.

servicelearning.org/library/lib_cat/index.php?library_id=1528

Austin, Suzanne S. and Charlotte L. Berceci. When Will I Ever Use This Stuff, Anyway? *Mathematics Teacher*, v.92(9),1999, 798-799.

The authors used service-learning to show intermediate algebra students at a large urban community college how to understand and appreciate math. The outcome transcended the classroom and best motivated students by helping them realize how important mathematics is to their futures.

servicelearning.org/library/lib_cat/index.php?library_id=5614

Duke, Johnny I. Service Learning: Taking Mathematics Into the Real World. *Mathematics Teacher*, v.92(9), 1999, 794-6.

Mathematics courses often have little practical application for solving problems in the real world. Service-learning helps to bridge this gap at the elementary, secondary, and higher education levels.

servicelearning.org/library/lib_cat/index.php?library_id=5611

Hadlock, Charles R. *Mathematics in Service To The Community: Concepts And Models For Service-Learning In The Mathematical Sciences*. Washington, DC: Mathematical Association of America, 2005.

This book looks at the wide variety of ways in which math, statistics, and math education teachers have incorporated service-learning into their courses. These projects are not just stand-alone community service initiatives, but rather they specifically target the improvement of mathematics skills and insights of the college students in the courses with which they are associated. The book includes a lengthy chapter on the details of converting a rough idea to a solid action plan, and displays a wide range of successful projects in order

to encourage readers to develop some of their own.
servicelearning.org/library/lib_cat/index.php?library_id=6436

Reid, Pamela Trotman, and Sally K. Roberts. Gaining Options: A Mathematics Program for Potentially Talented At-risk Adolescent Girls. *Merrill-Palmer Quarterly*, v.52(2), 288-304. In response to indicators that a decline in interest in mathematics occurs among girls - particularly those from low-income and minority groups - during middle school, the GO-GIRL (Gaining Options: Girls Investigate Real Life) program was designed to help potentially talented at-risk girls. The program aimed to build mathematical confidence, skills, and conceptual understanding by integrating mathematics and social science research in a single-sex, technology-rich environment supported by university student mentors. The program targeted seventh-grade urban girls from public and private schools. Participants met over the course of ten Saturdays to learn research methods, computer skills, mathematics, and descriptive statistics. Quantitative data from the girls indicate that participants demonstrated greater confidence in their mathematics ability and increased mathematics achievement after the program. Qualitative data confirmed these findings and supported the contention that multiple factors play a role in fostering girls' interest in studying mathematics and science. Girls were organized into teams led by university student mentors participating in a service-learning project. A powerful result was the role these mentors played in changes that occurred in the girls' skills and confidence levels. This investigation also illustrates the significance of service-learning in connecting the university, students, and the community in delivering effective interventions.
servicelearning.org/library/lib_cat/index.php?library_id=6749