



DIGITS Annual Report 2013 – 2014 Program Year

DIGITS is a sixth-grade STEM education/awareness program that pairs STEM professionals with sixth-grade classes throughout the state **to increase students' interest in math and science subjects and careers.**

Volunteers deliver messages about the importance of math and science, engage students in STEM related hands-on activities, talk about their own career paths, and motivate students to consider a STEM career. As a follow-up to the volunteer's visit, DIGITS provides an Online Teacher Resource Package (OTRP), a portfolio of STEM activities, multi-media content, websites, and resources that teachers are using to supplement classroom instruction throughout the school year. Created by leading Massachusetts science and technology associations, DIGITS was recognized as an @Scale project and endorsed by the Governor's STEM Advisory Council as a successful, measurable, and scalable program. DIGITS has completed its fifth year of implementation in schools across the Commonwealth.

The primary program message that volunteers share with students is that if they study/learn all the math and science they can, they will have many exciting career opportunities available to them. Students are encouraged to view math and science in a positive context, to see these subjects as the foundation for and gateway to a better future, and to recognize that many important things around them are based on math and science.

This annual report highlights the program's activities and accomplishments during the fifth year of implementation and documents the impact of the program on students, teachers, and volunteers. In addition, we have reached a number of important milestones over the first five years of the program.

PROJECT MILESTONES

Reach

- 20% or more of all the sixth grade public school students in the state have participated in the program each year for the last three years.
- Half of all eligible schools in the state (public schools with a sixth grade) have participated at least once in the program over the last five years.
- Half of all participating companies over the last five years have provided employees more than one year.

Impact

- Each year, the independent evaluator has documented that students show an increased interest in math and science and greater knowledge of STEM careers – as a result of the program.
- The evaluator reports that teachers are now incorporating DIGITS messages into their ongoing teaching.

Recognition

- One state education official said that DIGITS is the only program in the state bringing STEM professionals into classrooms to promote STEM careers.
- DIGITS has been endorsed by the Governor's STEM Advisory Council as an @Scale program – recognizing that the program is successful, measurable, and scalable.

DIGITS Facts and Figures: A Statistical Profile

STATS FOR ACADEMIC YEAR 2013-2014

Schools

15,220 students participated in DIGITS – 21% of all the sixth graders in the state

In 121 schools located in 82 cities and towns

77% of schools participated more than one year; 32% hosted program 4-5 years

57% of schools were Title 1 schools with a high percentage of at-risk students

Volunteers

188 volunteers visited classrooms across the state from a total of 61 companies

Averaged 81 students per volunteer

50% participated in the program more than one year; 9% participated four or five years

Volunteer Demographics

48% Female

23% Minority

48% Have advanced degrees

36% Under the age of 40

15% Speak another language

Volunteer-STEM Sector

53% - IT

16% - Life Sciences

13% - Manufacturing

6% - Engineering

12% - Energy, State agencies, Other

STATS FOR ALL FIVE YEARS – 2009-2014

67,130 students participated in the program

In 297 schools in 160 cities and towns

52% of schools participated more than one year; 15% of schools participated 4-5 years

54% of schools in the last five years were Title I schools

784 volunteers visited classrooms across the state from a total of 121 companies, state and federal agencies, universities and other organizations enabled their employees to volunteer

Averaged 86 students per volunteer

16% of participating STEM professionals volunteered two or more years

3% of participating STEM professionals volunteered four or 5 years

Average of 45% female volunteers

Average of 24% minority volunteers

Average of 53% with advanced degrees

Average of 44% of volunteers under the age of 40

Average of 21% of volunteers speak another language

49% - IT

19% - Life Sciences

14% - Manufacturing

8% - Engineering

10% - Energy, State/Federal, Other

Key Findings and Accomplishments

1. Evaluation Highlights: Positive Evaluations from Students, Teachers, Volunteers

The findings, collected and analyzed by the independent evaluator, Dr. Diane Schilder of Evaluation Analysis Solutions, Inc. focused on the impact of the project on students, teachers, and volunteers. Evaluation methodologies included pre and post (immediate and delayed) surveys of students as well as online surveys completed by both teachers and volunteers. Dr. Schilder also prepared an additional online questionnaire, administered late in the school year, to determine the use and value of the Online Teacher Resource Package. Dr. Schilder and project leaders consulted approximately once a month over the calendar year to examine evaluation issues.

A. Important Student Outcomes

Students had extremely positive feedback about the program. In total, 372 matched pre-post student surveys were evaluated. Students:

- Showed increased interest in STEM subjects and increased knowledge of STEM careers as a result of the program.
- Showed statistically significant increases in understanding that such terms as cancer research, cell phones, designing and building things are associated with STEM
- Showed statistically significant increases in reports that they plan to pursue a career in science
- Rated the overall quality of DIGITS as high.
- Boys were significantly more likely to report an increase in the belief that it is important to know science to get a good job.

B. Important Teacher Outcomes

Teachers viewed the STEM Ambassador visits and the DIGITS materials very favorably. Most of the teachers participating in the program taught science. In total, 77 teachers responded to the survey. In regard to their professional backgrounds, 44% had K-8 teaching licenses, 33% had middle school licenses, and 10% had initial K-8 licenses and 26% had initial middle school licenses. Most of the participating teachers indicated that they had participated in math or science professional development during the past year.

- 93% wanted another STEM Ambassador in their classroom in the future
- 89% rated the overall DIGITS experience as good or excellent
- 87% would recommend the program/volunteer visits to others
- 82% reported the visit helped students understand the importance of math and science
- Many teachers who had participated previously reported that they incorporated DIGITS messages into their ongoing teaching.

C. Important Online Teacher Resource Package (OTRP) Outcomes

This was the second year that the Online Teacher Resource Package was broadly available to teachers who hosted a DIGITS volunteer. The teachers who accessed the OTRP had a very positive response to the portfolio of STEM materials and resources accessible from the DIGITS website. In total, 23 teachers responded to the OTRP survey.

- 65% of the teachers completing the survey implemented one or more activities from the OTRP
- 94% reported that the types of activities and the range of information about the activities was good or excellent

D. Important STEM Ambassador Outcomes

STEM Ambassadors had very positive and successful classroom experiences. In total, 85 volunteers responded to the survey – 45% of this year’s STEM Ambassadors.

- 96% rated the quality of the training as very high or high
- 96% felt prepared for the DIGITS classroom experience
- 96% reported that they hoped to participate in the program again
- 94% were able to engage the teacher in implementing the program in the classroom
- 94% rated the quality of DIGITS materials as good or excellent
- 89% reported that the teachers were enthusiastic about the experience
- Half of participating STEM Ambassadors had participated in the program previously

Volunteers were very enthusiastic about their participation in the DIGITS program and provided information about how they talked about their careers and sparked students’ interest in STEM:

I described how our company uses a different algorithm to move information around the internet faster than the "regular" Internet does. (I checked to make sure everyone knew what an algorithm was first.) The kids thought it was very cool.

I brought in a 1/48 scale model of a Gulfstream G650 Jet along with a photo of the cockpit instrument panel, and photos of a cabin interior.

I shared photos of myself at various field locations (Death Valley, Hawaii, Iceland, Oman). I showed a picture of my lab and some safety equipment I use in lab (dark glasses for eye protection while melting glass tubing). I brought in some carbonate rocks that I study as a geochemist, blew up a balloon, and had the students guess how many balloons-worth of carbon dioxide were stored in the rock (~50).

I presented two posters, one the NASA Mars Mission I worked on at my previous position, and one on a radiocarbon dating project performed at my current position, where we dated Black Beard's pirate ship. I also brought liquid nitrogen, which we regularly use in lab, and performed several demonstrations with it.

I showed an animated 3-dimensional model of a virus protein and the drug that binds to it on the projection screen. I am a co-inventor of the drug.

I spoke about bedside medication verification and described how nurses could scan the barcode on a patient's bracelet and the barcode on a medication to make sure they had the right patient, the right med and the right time – to avoid allergies and patient mistakes.

I brought in a robot that the kids took turns driving around the classroom. They loved it! We talked about the current and future uses and showed a short video of it in use.

I showed them a video clip of a cardiac ultrasound from a real patient and we talked about how science and math were required for every step of this imaging procedure: from building the

machine to take the pictures, to understanding how the physiology of the heart knows so that the doctor can use the pictures to guide therapy. They were "wowed" I think!

I described my time working on a research vessel in the Gulf of Mexico collecting sperm whale skin samples. I brought photos of the boat and some of the wildlife we encountered.

I brought in a variety of objects to show them how many different kinds of things can be designed using our software, and to make the point that almost everything made by humans requires engineering. My props were: disposable diaper, running shoe, baseball helmet, water bottle, toy robot and pictures of a jet airplane, car, and soccer ball.

I used lego creations (a car, a tower building, and a plane) and talk about how they get designed and what tests they need to pass for safety; then talk about how my works helps in that process.

I used an iPhone, LED Flashlight and LED TIR Lens to describe the types of problems my customers solve. This includes the design of the phone display, cameras, electronics and flash for the phone.

I discussed the basics of photosynthesis, how my company uses photosynthetic bacteria to route Carbon to making fuel instead of sugars

I talked about how I design user interfaces and I showed our iPad application that allows users to display an item designed in our software in the room. With a projector, we can make an image of something like the jaws of life appear in the classroom (on the iPad screen).

I brought in a 3D printed model to show one of the cabinets we build at the plant. I also brought some stock 3D printed parts that move, chain, crescent wrench, puzzle with sliding parts. I talked about the shock requirements that our equipment has to meet for the things we design for Navy submarines.

2. Communications and Partnerships

Over the last 5 years, project leaders have provided quarterly reports and annual reports to sponsors, corporate partners, volunteers, teachers, and other constituencies to keep them up to date on how the program has progressed. Other communications activities include:

A. Digital Communities

Funders, partners, and others interested in the program stay connected to DIGITS through social media - primarily the [DIGITS Facebook page](#) and the [DIGITS blog](#). We also had successful interactions with our volunteers through our **Linked In** DIGITS STEM Ambassadors group. The group was developed in response to feedback that first-time volunteers wanted to connect with veteran volunteers before entering the classroom and other feedback that volunteers wanted to share information on their classroom experiences. In total, 198 volunteers are currently members of the DIGITS LinkedIn network. Of the 34% who responded to this year' survey, 81% reported actively using the network. Members include volunteers who have participated 1-5 years over the life of the project.

B. Increased Visibility

DIGITS received coverage in a number of media outlets over the course of the year detailing regional visits and program precepts. Coverage included a photo essay with visit description in the **Berkshire Eagle** (Berkshires

region); highlight of the Massachusetts STEM model and specifically the DIGITS approach including a Central Massachusetts classroom visit in the *Providence Business News* (Worcester County region); volunteer account of a DIGITS visit to a Newton classroom in *Village 14*, an online forum covering all things Newton (Greater Boston regions); an article on Congressman Joe Kennedy's visit to a Taunton Middle School featured in the *Taunton Gazette* and in a national STEM news publication called *STEMConnector.org* (Southeastern region); and the publication of an article on DIGITS work and future plans in Springfield in *Point of View*, a bimonthly news magazine (Western Mass region). In addition, DIGITS issued press releases in every region of the state detailing the cities and towns that participated, number of students reached, companies that provided volunteers, and background information on the program. See copies of all these articles in the media section of our website that features press releases and news clips. <http://digits.us.com/about/news/>. DIGITS was also featured in a publication produced by the Governor's STEM Advisory Council highlighting STEM activity in all the @scale recognized programs.

DIGITS staff participated in nine corporate events over the course of the last program year at **Broadcom, Dassault Systemes, MassMutual, Millennium/Takeda Pharmaceuticals, Natick Labs, Novartis, SIM (Society for Information Management), Shire** and the **Worcester Chamber**. These appearances help in recruiting efforts and reinforce relationships with company partners and sponsors. In addition, DIGITS was an exhibitor at a Southeast STEM Network meeting and the annual meeting of the Massachusetts Medical Device Industry Council. Project leaders also presented information about DIGITS and the STEM challenge to a variety of organizations. These presentations focused on the critical nature of the STEM challenge in the state and highlighted DIGITS' role in addressing it. Finally, DIGITS staff attended/participated in other STEM-related events including the Governor's STEM Advisory Council meetings and events, statewide STEM Summit, Congressman Joe Kennedy-led Roundtable on corporate sponsorship of STEM programs in the state, Mass Life Sciences Innovation Day, Global STEM Education Conference, and Raytheon-sponsored opening of the Math Alive exhibit at the Museum of Science.

DIGITS also hosted **Congressman Joe Kennedy** and **MathWorks executives** in a DIGITS classroom at the Friedman Middle School in Taunton where the Congressman led students in DIGITS activities and a MathWorks volunteer talked about her career and engaged the students in a robot activity. A video of this exciting event is being created and will be posted on our website.

Lead Sponsor **MathWorks** prepared a video, for their internal use, featuring their partnership with DIGITS and including clips of a teacher interview, MathWorks volunteer in the classroom with students at the Stacy Middle School in Milford, and an interview with DIGITS Founder and CEO.

C. STEM Networks

DIGITS partnered with seven regional STEM Networks over the last academic year including Berkshires, Boston, Central, Metro West, Northeast, Pioneer Valley, and Southeast. We are grateful to all of these networks that assisted our implementation by communicating with their constituencies on behalf of the program.

D. Corporate Partnerships

Lead Sponsor MathWorks again combined their interest in and sponsorship of both DIGITS and the Museum of Science by underwriting field trips to the Museum of Science for deserving students in schools outside Route 495. Special thanks to MathWorks for making this field trip possible for approximately 600 students from all

three public middle schools in Taunton. MathWorks' efforts were recognized by Congressman Joe Kennedy during his visit to a Taunton public school.

3. Funding: Sponsors Support DIGITS

Originally funded by the Massachusetts Department of Higher Education STEM Pipeline Fund and the Massachusetts Technology Leadership Council, 2013-2014 DIGITS activities were supported by funding from 14 companies/foundations/state agencies/individuals. This funding made it possible to provide the program free to public schools over this past academic year. Sponsors include:

Lead Sponsor **MathWorks, Massachusetts Department of Higher Education STEM Pipeline Fund, Massachusetts Life Sciences Center, Google (through the Tides Foundation), Meditech, Irene E. and George A. Davis Foundation, Millennium/Takeda Pharmaceuticals, IBM, Samuel and Nancy Jo Altschuler, Berkshire Bank, Cisco, Dassault Systemes, Broadcom, and PTC.**

In addition, DIGITS is grateful to IBM for a generous gift of software and services. The IBM Smart Cloud for Social Business contribution will enhance DIGITS' digital infrastructure enabling web meetings, online communities, document sharing and other services.

4. Participating Cities/Towns 2013 – 2014

A. Cities and Towns – (at least one school from the following cities/towns)

Acton, Arlington, Attleboro, Baldwinville, Bellingham, Billerica, Blackstone, Bolton, Boston, Braintree, Brookline, Charlton, Chelmsford, Chelsea, Cheshire, Clarksburg, Dalton, Douglas, Dracut, East Bridgewater, East Longmeadow, Everett, Fitchburg, Florida, Framingham, Gardner, Great Barrington, Groveland, Hamilton, Hancock, Harwich, Haverhill, Hudson, Lancaster, Lawrence, Lee, Leominster, Lexington, Lowell, Lynnfield, Malden, Marblehead, Marlborough, Mashpee, Medford, Middleborough, Milford, New Bedford, Newbury, Newton Centre, North Adams, North Easton, Petersham, Pittsfield, Princeton, Revere, Rockland, Royalston, Rutland, Sandwich, Scituate, Sheffield, Somerset, Springfield, Swampscott, Taunton, Tewksbury, Townsend, Uxbridge, W Yarmouth, Wakefield, Waltham, Webster, Wellesley, West Brookfield, West Warren, Westborough, Westfield, Weymouth, Williamstown, Worcester, Wrentham

B. Companies/Organizations/State Agencies (at least one volunteer from the following companies)

AbbVie Bioresearch Center, AccuRounds, Akamai Technologies, Analog Devices, Applied Materials, Avaya, BEK Associates, Berkshire Medical Center, BigBelly Solar, Broadcom Corporation, CDM Smith, Court Square Group, Dassault Systemes, EMC Corp, EMD Serono, Federal Aviation Administration, GE Aviation, General Dynamics, Genesis Rehabilitation, Google, Gulfstream Aerospace, Hasbro, Hill Engineers Architects Planners, IBM, Jacobs Engineering Group, Joule Unlimited, Karl Storz Endoscopy, Keurig, Litle & Co, Louis Berger, Lowell Observatory, Luvak, Mass College of Liberal Arts, Mass. Department of Environmental Protection, Mass. Department of Public Health, MathWorks, Meditech, Millennium/Takeda Pharmaceuticals, National Oceanic and Atmospheric Administration, Nitsch Engineering, Novartis Institutes for Biomedical Research, Nuance Communications, Ocean and Coastal Consultants, Parsons Brinckerhoff, PerkinElmer, Propel Careers, Raytheon, Shire, Siemens, Synopsys, TECET, Tighe Bond, UMass ITS, Verizon, Vertex, Waquoit Bay Research Reserve, Woods Hole Oceanographic Institute, Wright-Pierce, Year Up and 2 life sciences consultants.

5. Comments from Students, Teachers, and Volunteers

Quotes from Students:

I learned that to get a really good, high paying job in the future, you must be very good in science and math.

I learned that if you work hard you can achieve your goal.

I learned that if you work together you make something better and use teamwork.

What I learned from the Digits Ambassador is, math, science, and technology is all around you and you can't avoid it.

I learned from the DIGITS STEM Ambassador that you need to work hard to get the job you want.

I learned that you can build anything once you put your mind to it.

I learned that you can do way more things with science than you thought you could.

I learned that it takes a lot of knowing math and science and technology. Also before making it there is a lot of designing and drawing first.

I learned that there are about 23 billion cells can fit in a tiny tube.

I learned how software works.

I learned about different types of jobs and different types of thing they do in the lab.

I found out that contractors and builders are scientists too.

I learned about cancer and how they try to cure it. I also learned to always try to do more than what's asked.

I learned how a robot is controlled and how it looks in motion.

What I learned is robots are really cool and fun to build.

I learned that science is used for everything.

Quotes from Teachers:

I felt that the activities were student friendly and allowed for great discussion. The kids were excited about them. The Ambassador's personal story was the best part. It really showed the students what opportunities were available to them. I loved the name exercise. It was nice to hear what students are interested in. Ambassador brought lab coats for students too and they loved them. The experience was great. I liked the props he brought in.

Students need to know why math and science are important. Hearing about careers in STEM fields is a great way to do that.

Students get excited when they can learn about locals that became successful through doing well in school.

I love the program and have had it in my classroom since I began teaching. It is very important to pique students' interest in the math and science field.

The program brings to light careers many students may not be aware of and how the field is growing and new jobs are evolving all the time.

It was a valuable experience for students to hear from a real person who is passionate about his job in a STEM field.

My students got firsthand experience on how math and science can relate in the real world. It was insightful.

Students learned a lot about possible jobs in the science/tech/math fields that they didn't realize were options. It was good for me to learn about some of these jobs as well because I can share and discuss them with future students.

I learned how math, science, and engineering applied to different work professions and how the skills of one profession can overlap into other professions.

Students were able to learn the importance of computer technology in our society.

It's a valuable experience for students to see and listen to professionals from the field. Students too often ask the question, "Why do I need to learn this?" DIGITS answers this question.

Quotes from Teachers regarding the Online Teacher Resource Package, a portfolio of STEM activities, multi-media content, websites, and resources provided to DIGITS teachers to supplement classroom instruction:

Great websites that have many activities to choose from.

This looks like it is going to be a very valuable STEM resource. I am a STEM resource teacher helping teachers integrate STEM across the curriculum. I will recommend this site to our staff. I use almost all of the engineering websites listed. I will check out the 2 listed that I just learned about from your site!

I have seen many of the activities (spent some time reading about them and copying and collecting some for my use for next fall). I also copied the list of websites for math, science, and engineering, so that I share them with my 6th grade partners who also teach math (I teach both math and science).

I am designing a science curriculum for next year for 6th grades and am using some of the links and sites to augment my units. I have not used any of the lessons yet but plan to.

I will stay tuned to this website as it grows and I will use activities for both professional development to make teachers more comfortable integrating STEM and also with students in my 6-8 school.

I have not been able to this year, but I have already begun planning activities for next year based on what I have downloaded off of the site.

Quotes from Ambassadors:

It was a fun, different experience for me. Given the shortfall of STEM interest in Massachusetts, particularly when coupled with my company's challenges in hiring qualified software engineers; I thought that this exercise was particularly compelling.

I enjoyed the program. I felt that even if my visit only impacted ONE kid, it was worth it. (Mind you, besides the time to prepare and take a 1/2 day off work, I also had to rent a car for the day to get from Cambridge to Revere!) But, I would do it again (and, I think be better at the whole thing!)

The program and materials are very effective. The students love the stickers and it provides a way to break the ice and talk about careers. The teachers are all very enthusiastic and are grateful. They all see a need to expose the students to careers in the STEM fields. I enjoy meeting the students and talking about how I got interested in electrical engineering.

DIGITS is great in that they connect the volunteers with the classrooms. The (school) location has been local to my home which is great. They also provide content and training that can be used in the classroom.

I really enjoy doing this program. It feels great to inspire other kids especially because it was in my middle school that I first became interested/passionate about science. It also reminds me why I love my job and how I got to where I am so its great to share that with the kids as well. I also just really enjoy seeing the kids be enthusiastic and participatory in the activity and see what they learned.

I believe that the program is extremely relevant as there are lots of STEM jobs available but few students out of school that have the training for these jobs. It is a responsibility for future generations of Americans and for our economy that we encourage students to fully understand the benefits of a STEM career as a major in college and/or future career.

6. Acknowledgements

DIGITS is very grateful to our sponsors, partners, volunteers, principals, and teachers for their involvement in the success of the DIGITS program. Initially developed by a coalition of STEM trade associations – Mass Technology Leadership Council (MassTLC), Mass Network Communications Council (now a part of the Mass TLC), The Engineering Center, Mass Biotech Education Foundation, Mass Medical Device Council and the New England Clean Energy Council, DIGITS was created in 2008, with creative input from advertising agency Arnold Worldwide, and first implemented in classrooms around the state during the 2009-2010 academic year. The program is offered in partnership with the Mass. Department of Elementary and Secondary Education, Massachusetts Association of School Superintendents, Massachusetts Elementary School Principals Association, and Massachusetts Secondary Schools Administrators' Association.

The DIGITS Project is an independent project that is affiliated with The Engineering Center Education Trust (TECET), a 501c (3) organization dedicated to STEM education. We are very grateful to TECET which serves as the host organization and fiscal agent for the program.

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