

CCSS/NGSS Pilot for Library Summer Reading Club: Informal K-8 STEM Learning as a Bridge for Formal Scholastic Learning

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Abstract

The applied research pilot project of this report seeks to advance K-8 STEM learning by bridging in-school, scholastic learning sessions with informal, out-of-school, summertime learning at public libraries. Professional library programming for children and families around reading and learning is already an integral component of meeting community needs, especially during the summer months when skills can be lost. Annually, and nationally, public libraries have been sharing a themed set of guidelines and

activities for Summer Reading Clubs, and activities for K-8 Summer Reading Clubs. The pilot program has been designed to professionally train librarians, administrators, and volunteers for orienting these children, their parents and guardians, to STEM learning in particular, based on scholastic Common Core State Standards (CCSS) in mathematics/English language arts, and Next Generation Science Standards (NGSS). This report describes the activities and progress in the first year of the two-year pilot, including results from an external evaluation.

Introduction

Public Library of the Conflicted Civic Mind

If a community is fortunate enough to have its own public library, that library is often openly associated with civic pride, and, at least within the core body of the library's users and supporters, with a genuine love of books and reading. For some modern-day cynics, nevertheless, the public library is perceived as only a side street of the new main road paved for the Internet. This paper will demonstrate that such a perception is false; we will show how libraries can reinvent themselves to an even larger educational purpose, one that is integral to scholastic STEM learning, and one that can better withstand cynical views.

The Murrysville Community Library is a non-profit corporation, with a Board of Directors, with its own Articles of Incorporation, with an annual budget plan, and with a strategic plan; it is no different from any other corporation, but because it serves at the pleasure of the community, the conflicting views between user and non-user, book-lover and cynic, impact annual funding and viability. In the state of Pennsylvania, where we serve in the southwest corner, there are 445 such public libraries and twenty-nine Districts into which the libraries are grouped regionally (PDE 2012). Districts sometimes correspond with counties.

On Building a New Model¹

In our District of twenty-four libraries, the Westmoreland Library Network (WLNTM), we are in the midst of piloting a new model, one that is intended to eventually overcome not only cynical perceptions, but complacency as well, and to fill a societal educational void (Greenberg and Faló 2014–15). This is really the goal of the pilot project. It integrates a summertime, K-8 educational library experience—based on Common Core State Standards in mathematics/English language arts and Next Generation Science Standards—with formal, standards-based, scholastic learning (NGSS 2014; PA Common Core 2012; Widener 2014). The two-year pilot is about bridging fall/winter/spring scholastic semesters with enhanced and more purposeful, standards-based summer programming. This paper is a report on the first year's activities and progress, including an external evaluation by the Collaborative for Evaluation and Assessment Capacity (CEAC), University of Pittsburgh School of Education.

Background

Library Strengths and Addressing a Weakness

In Pennsylvania, public libraries are well-established, stable resources for information access, reading for pleasure, and informal learning. They operate with a common core of information services. Library Directors and some other staff are trained at the level of a university M.S. Public libraries adhere to specific state library codes, and they operate under the state's Pennsylvania Department of Education, the Office of Commonwealth Libraries. However, while skilled in reading literacy, staff is rarely trained in STEM subject matter or pedagogy. The two-year pilot project in progress seeks to advance student interest in or disposition towards STEM, along with actual learning and understanding of STEM concepts, by building library staff capacity to include STEM in its programming and to make more connections with CCSS and NGSS standards. It seeks to reach across a full spectrum of learning groups in one large PA county/District, with rural to suburban to urban population, and also to be comprehensive with respect to gender, race, ethnicity, and economic means.

Summer Reading Club as Central to the Vision

Many public libraries in all fifty states already participate in an organized Summer Reading Club activity, using a nationally themed set of guidelines and activities structured by the Collaborative Summer Library Program (CSLP 2014). For 2014, the designated theme was "Science: Fizz, Boom, Read!," a first-time explicit focus on science in twenty years of theme-setting. The pilot is designed to take advantage of the established and ongoing reading program and its popularity, as well as the favorable theme. It is doing this by training library staff and key programming volunteers in advance of summer to orient children, parents, and guardians to CCSS/NGSS learning, under the banner of the Summer Reading Club. The collaborating trainers, who otherwise train scholastic teachers and administrators in their usual role, are Mathematics & Science Coordinators from southwestern PA's Math & Science Collaborative (MSC), of which more will be said below. Those who are trained then become trainers for all participants, hopefully leading to the lifelong standards-based learning for all that is needed throughout our society.

MSC Trainers and Library Trainees

For eleven counties, 138 public school districts and non-public schools, MSC stands as the area's comprehensive catalyst for advancement of K-12 STEM learning. MSC's multifaceted STEM program, by which 1250+ teachers and administrators have received training over about twenty years, has: (1) sustained a teacher culture of lifelong professional learning by the internal sharing of best practices and external enrichment; (2) taught teachers to take more personal responsibility for lifetime professional learning; (3) institutionalized a complex array of professional communication and training networks for teachers, administrators, and institutions of education; (4) established the MSC as a leading proponent for CCSS and NGSS standards. In 2012, the MSC earned the prestigious Carnegie Science Center's Leadership in STEM Education Award in recognition of its exceptional impact. It is well positioned to repurpose its usual teacher-training model for use in the public library world.

Key trainees include Library Directors, Children's Librarians, volunteers, and Board Directors. The Directors are important for building administrative support for the initiative; in 2014 four Directors from the Murrysville Community Library (MCL) Board and/or its fundraising MCL Foundation Board participated. The two Boards work closely, even sharing a Strategic Plan; two trainees serve on both Boards. For this first year, Murrysville Community Library was targeted as the particular focus for training, rather than the WLN District as a whole, although participants came from ten libraries in all. In 2015 the emphasis will shift to the WLN District as a whole. MCL's Library Director and Youth Services Coordinator participated fully.

MCL is a particularly good starting point for the pilot because of its depth of experience and recognized skill in children's programming. The MCL offers numerous special programs for patrons of all ages, both on-site and off, some seasonally. The Children's Library was recognized as the 2009 statewide winner of the prestigious PA Library Association's David J. Roberts EXCEL Library Service Award. Furthermore, the MCL consistently draws about 900 youngsters annually for its Summer Reading Club, which is significant in a service area of about 28,000 people.

Specific Goals and Hypotheses

The project's specific goals are (1) to incorporate STEM learning in nationally themed K-8 Summer Reading Club

programming in public libraries, as well as other children's programming during the year, as informed by curriculum grade-level standards; (2) to bridge grade-level learning during the otherwise low-STEM-content, out-of-school summer months; (3) to make volunteers and family members a part of the learning, so that children and their families realize enrichment in both the library and home settings. The year-one parental experience is limited to on-site observation and/or child engagement at home; more direct training may be possible when staff members are better prepared as trainers themselves.

The research and development hypotheses are that: (1) in-school student STEM learning can be advanced, given continuity, and sustained by repurposing in-school MSC practices to out-of-school children's programming in public libraries; (2) all children can learn science and mathematics; (3) awareness and knowledge of 21st-century skills for life-long, "life-wide," and "life-deep" STEM experiences can be fostered in public library settings for family groups.

Methods

Workshops

Eight half-day training workshops were conducted from January through April 2014. Each was led by a pair of staff members from the MSC, most often paired as two Science Coordinators or two Math Coordinators. The workshops included explanative discussion by the Coordinators, hands-on activities, and extensive interactive discussion. The hands-on activities were connected to children's literature that served as the pathway to important mathematics and/or science processes and content.

For example, one session focused on number and shape patterns. The MSC facilitator read aloud the story "The Grapes of Math" (Tang 2004). Trainees then worked in small groups to solve a particular riddle from the story. Each trainee group shared its riddle and solution strategy with the other trainee groups. The ensuing plenary discussion focused on the following essential questions:

- What mathematical or scientific concepts/ideas did the riddles (or activity) illuminate?
- What insights/ideas did the activity leave with you?

TABLE 1. Some Workshop Topics and Resources Used

Topic(s)	Type	Resources in Notes ²	Featured CCSS/NGSS
Archimedes displacement	Science	The Inquiry Project 2011	5-PS1: Matter and Its Interactions
Density and buoyancy	Science	Home Experiments 2012	5-PS1: Matter and Its Interactions
Density and heat energy transfer	Science	Yang 2007	HS-PS1: Matter and Its Interactions; HS-PS3: Energy
Friction	Science	Robertson 2014; Keeley 2013; Cole et al. 1998	3-PS2: Motion and Stability: Forces and Interactions
Species adaption	Science	Keeley and Tugel 2009	MS-LS4: Biological Evolution: Unity and Diversity
Center of gravity	Science	FOSS	K-PS2: Motion and Stability: Forces and Interactions
Color and chromatography	Science	ICE 2012	1-PS4: Waves and Their Applications in Technologies for Information Transfer; 2-PS1: Matter and Its Interactions
Water Cycle	Science	Project WET 2009	5-ESS2: Earth Systems
Mean, median and mode	Math	Munsch 1992; Math Solutions 2009	6.SP.B.5: Summarize Numerical Data
Patterns	Math	Tang 2004; MARS 2003	4.OA.5: Number and Shape Patterns
Engineering design	Eng	EIE 2014	3-5-ETS1: Engineering design

- With which standards of mathematical practice (or science and engineering practices) and English language arts capacities did the riddles most require you to engage? Why?
- What are the implications for planning your summer reading program? How might you use a task/story/activity like this in the summer reading program?

Additional examples of the mathematics and science content of the exercises are summarized in Table 1.

The number of workshop attendees ranged from ten to twenty-two, averaging eighteen. In total, there were thirty-four unique attendees for the purposes of the external evaluation to be discussed below, of which thirty-one were library trainees. The additional three were community leaders with a stake in the outcome (Mayor, Superintendent of Schools, and Assistant Superintendent); these three attended part of one workshop each. The Program Officer and a Board Director from the lead funding agency participated at part of one workshop. The number of workshops attended by library trainees ranged from one to eight, but each workshop was sufficiently illustrative of CCSS/NGSS learning that a trainee could get the main points in one session. In general, additional sessions served to reinforce learning with new math and/or science process/content connections to children's literature, to be applied during the coming Summer Reading Club.

A Venn diagram from Michaels (2013, 59), showing the CCSS/NGSS standards for mathematical practice, science and engineering practices, and English language arts capacities, was used repeatedly as a thumbnail point of reference. The trainers discussed the fuller descriptions for each set of practices as well. They provided all trainees with more extensive written content in three-ring binders, to which ongoing reference was made. These standards describe the proficiencies being targeted for the trainees, mirroring those exhibited by a mathematically and scientifically literate individual. At every workshop, the appropriate standards were discussed in the context of exemplary, hands-on exercises, each of which was done typically in groups of three or four. The intent was always to help the trainees understand the processes and proficiencies of mathematics and science, including how to reason in a professional way, and how to communicate in an informed way. Thus, the training was about more than just mathematical and scientific content, although that too was embedded in the exercises.

External Evaluation

The MCL contracted with the University of Pittsburgh's Collaborative for Evaluation and Assessment Capacity to evaluate the 2014-2015 program. Two surveys were constructed to examine the effect of the program on the students and the library staff, administrators, and volunteers who participated in the training, particularly with regard

TABLE 2. Examples of Survey Questions

Questions to Training Participants Scale: 1=Strongly Disagree, 2=Disagree, 3=Uncertain, 4=Agree, 5=Strongly Agree	
As a result of the math and science professional development,	
I better understand math and science concepts.	
I better understand how children think about math and science.	
I am better able to answer children's math and science questions.	
I am more confident in my ability to further children's math and science knowledge through appropriate resources.	
I can better help children appreciate the value in learning math and science.	
I am more confident in my ability to provide math and science programming.	
I can better assist families in helping their children understand or learn about math and science.	
I feel motivated to seek further information and training regarding math and science.	
Questions to Children Scale: 1=Disagree, 2=I do not know, 3=Agree	
After participating in the Science: Fizz, Boom, Read! summer reading program,	
I am more interested in science.	
I want to read more books about science.	
I want to attend more programs about science.	
I understand science better.	
I talk more about science with my friends and family.	
I will use the library to learn more about science.	
I will ask the librarian questions about science.	
I am more interested in television shows about science.	
I am more interested in science experiments.	
I am more interested in jobs in science.	

to how their familiarity and understanding of mathematics and science concepts progressed. Training participants were contacted via email to complete the participant survey, while parents of children who participated in the program were asked, via email, to provide the survey to their children and to assist them in its completion. Survey responses addressed the following evaluation questions:

Q1: Do participating library staff, volunteers, and/or third parties develop or extend their knowledge and understanding of STEM content and learning engagement strategies?

Q2: Do participating library staff, volunteers, and/or third parties develop or extend their application of STEM content and learning engagement strategies?

Q3: Do child and adolescent learners engage with STEM concepts and processes in their involvement in the Summer Reading Club and/or their use of the library during summer months?

Q4: Do child and adolescent learners exhibit more positive perceptions of and attitudes toward STEM concepts and processes as a result of their involvement in the Summer Reading Club and/or their use of the library during summer months?

Input data were analyzed using basic descriptive statistics for scaled responses. Qualitative analysis strategies were used for open-ended responses. Sample survey questions are shown in Table 2.

Results

Of the 34 workshop participants who were surveyed by the CEAC, 68% (n=23) responded, all of them library staff/administrator/volunteer trainees (Winters and Wade 2014). As for parents and children who participated in the program, about 6% (n=61) of the total of participants responded to the survey. The key findings from the report are as follows:

Key Findings for the Training Participants

- (1) Roughly half of the training participants (57%, n=12) had never received any prior professional development in mathematics and/or science.
- (2) More than two-thirds of respondents (71%, n=15) strongly agreed or agreed that they are better able to answer students' questions about various STEM concepts and assist families in helping their children to learn and understand math and science.
- (3) A large majority (81%, n=17) indicated greater confidence in their ability to select more appropriate resources to improve children's knowledge of mathematics and science.
- (4) A large majority of respondents (86%, n=18) indicated that as a result of the training they better understood how children think about mathematics and science.
- (5) Nearly all respondents (90.5%, n=19) indicated that as a result of the training program they could better help children appreciate the value of learning math and science.
- (6) Nearly all open-ended responses indicated that respondents could better help students to appreciate the value in learning mathematics and science as a result of training participation.

Key Findings for the Students

- (1) Gender and grade level seemed to be non-factors for student enjoyment of Summer Reading Club; however, girl respondents indicated a greater interest in science than boy respondents as a result

of participating in the *Science: Fizz, Boom, Read!* program (girls: 80%, n=24; boys: 61%, n=19).

- (2) More than three-quarters of student respondents (77%, n=47) had previously participated in library programs.
- (3) Over half of the students (54%, n=32) indicated that, as a result of participating in *Science: Fizz, Boom, Read!* they understood science better.
- (4) Almost three-quarters of student respondents (73%, n=43) indicated an increased interest in science as a result of the *Science: Fizz, Boom, Read!* program.
- (5) Over half of student respondents (51%, n=30) indicated that they would use the library to learn more about science. Of these 30 students, 53% (n=16) indicated that they were more inclined to ask librarians questions about science.
- (6) A large majority of student respondents (81%, n=48) stated that they wanted to attend more programs about science and were more interested in science experiments as a result of the *Science: Fizz, Boom, Read!* program.

Discussion and Summary

Although the above results represent only the earliest product of what is perceived to be a multiyear and ongoing growth process, they are entirely positive and encouraging. Both trainees and students affirmed the multiple benefits to their relationships with STEM from the experience. The responses are consistent with the earlier brief report of Greenberg and Faló (2014–15), made before CEAC's external evaluation was done. Certain early outcomes are noted in that report. The most important are these: (1) children's librarians from multiple libraries began immediately to plan together for the year's Summer Reading Club, which they had not done before; (2) librarians expressed appreciation for having had identified for them STEM children's books of high value and credibility; (3) as a given, for the first time, there is now an ongoing working collaboration among scholastic trainers

and librarians (as evidenced now by the co-authorship of the present report).

In the second-year Summer Reading Club 2015 timeframe, the K-8 theme is known to be *Every Hero Has a Story*. This theme is not explicitly science-based, as was the year-one theme, but it does still serve as a framework for introducing STEM content. Indeed, every theme can be made to include STEM content. In this case, some of the heroes will actually be scientists, mathematicians, or engineers. Some will be non-scientists who use STEM. For example, a fireman hero learns to extinguish fires using chemical combustion principles. Similar strategies can be applied generally for topics yet unnamed in subsequent years. In that way, as librarians gain knowledge and skills, they will continue to create programs and provide informed resources that encourage patron interaction with STEM concepts, even while continuing to promote reading skills and language arts.

In 2014, a first step was taken to introduce the pilot and its intent to the Superintendent of Schools and the Assistant Superintendent for Murrysville. This was done through their participation as trainees and by off-site exchanges. Each participating library will need to make this an ongoing effort.

Finally, returning to the question of whether the public library has become just a side street to the main Internet thoroughfare: it has not, or at least it should not have done so, for one main reason. The Internet is a place to find everything, both information that is informed, correct, and professionally referenced, and information that is not. This goes to the matter of quality of information, and consistency with respect to quality, and, in the case of STEM subjects, adherence to the scientific approach itself. Thus, the Internet has an inherent weakness. Anyone can add information to it, and do so without rules as to quality, and no one is responsible for showing the reader or user how to differentiate. With proper training, the same is not true of public libraries; a well-trained and present staff can make the difference, for using both the local collection and the Internet. The first year of this project has shown that staff consciousness has been raised in respect to choosing quality STEM resources for collection-building and programming, including Summer Reading Club programming. This outcome alone convinces us that we are on the right track with this project.

Our goal for the second year of sponsored training is to expand participation within our District to a broader population of staff members, administrators, and volunteers, including

both new and repeat participants. We have also arranged to have at least one participant from a contiguous District attend a training session, with the purpose of possibly expanding the program to her District. Ultimately, depending on outcomes, we imagine at least a statewide presence for STEM training, with goals similar to those of this pilot.

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Notes

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