STRENGTHENING THE CONNECTION BETWEEN THE SCHOOL LIBRARY AND MATH AND SCIENCE

by

Janet E. Bader

An Abstract of a research paper submitted in partial fulfillment of the requirements for the degree of Master of Science in Library Science and Information Services in the Department of Educational Leadership and Human Development University of Central Missouri

May, 2014
ABSTRACT

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There is a need to increase student achievement and career entry in the Science, Technology, Engineering, and Mathematics (STEM) fields in the United States. This paper is a review of the literature regarding the lack of existing collaboration between school librarians and math and science teachers and methods to increase this collaboration in order to increase student achievement in these areas. Results of the review indicate that when a collaborative relationship exists between school librarians and math and science teachers, student achievement improves.
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WARRENSBURG, MISSOURI
ACKNOWLEDGEMENTS

I would like to thank all those who assisted me during the formation of this paper. This includes my advisor Dr. Jennifer Robins for her patience and assistance during this process and Rene Burress for devoting her time as a second reader of this paper. I would also like to thank my family for their support during the time spent working on this.
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CHAPTER 1
INTRODUCTION

Statement of the Problem

Currently students in the United States score below average in math and science achievement when compared to other nations ("American Kids Don't Add Up" 18). There is concern that U.S. schools are not preparing students to enter STEM (Science, Technology, Engineering, and Mathematics) fields (Kuenzi 1). Research supports that collaboration between teachers and school librarians raises student achievement ("School Libraries Work" 6). Unfortunately, there is evidence that collaboration between school librarians and math and science teachers is lacking (Mardis, "School Libraries and Science Achievement").

Purpose of the Study

The purpose of this paper is to review the literature pertaining to collaboration between the school librarian and math and science teachers. This paper reviews literature regarding the reasons for a lack of collaboration and methods to increase collaboration between math and science teachers and school librarians. It also reviews projects that school librarians and math and science teachers collaborate on and lists math and science resources that the school librarian can share with teachers.

Research Questions

Studies indicate that collaboration between teachers and school librarians raise student achievement ("School Libraries Work” 6). Further evidence suggests school librarians collaborate little with teachers of math and science (Mardis, "School Libraries and Science Achievement"). However opportunities do exist for school librarians and these teachers to
collaborate to raise student achievement. This paper reviews literature that examines the following questions.

1. Why is collaboration necessary between school librarians and teachers of math and science content areas?
2. What are reasons math and science teachers do not collaborate with school librarians and vice versa?
3. How can school librarians move toward a collaborative relationship with math and science teachers?

Limitations of the Study

The primary limitation of the study is the availability of current research on collaboration between the school librarian and teachers of math and science. This area is understudied, so there were limited resources. Only a few professionals in the field have studied the benefits and methods of collaboration between school librarians and teachers of math and science. In addition, the results of the literature review cannot be comprehensively used by all educators. The scope of this study is limited to the topic of collaboration between school librarians and teachers of math and science.

Definition of Terms

The following definitions are terms used in this paper.

Environmental print: Print that people encounter during the daily course of their day such as advertisements, newspapers, catalogs and signage.
Informational trade books: Nonfiction books not including textbooks written about a specific topic in a field of study.

Pathfinders: A list of online resources created to help users find information.

STEM: An acronym used when referring to the fields of study that include Science, Technology, Engineering, and Mathematics.

Traveling library: Library information resources delivered to a classroom for a specific research purpose.

Research Design

This paper is a review of current articles published regarding collaboration with the school librarian, particularly with math and science teachers. No new research was conducted in this study. Existing published literature about this topic was studied for the purpose of this paper.

Literature for this paper was accessed online through The James C. Kirkpatrick Library at the University of Central Missouri. The databases Library, Information Science, and Technology Abstracts and Library Literature and Information Science Full Text were used as well as Google searches. Search terms included “libr* collaboration,” “math teachers,” “science teachers,” and “STEM.”

Conclusion

This paper contains three chapters pertaining to how collaboration between the school librarian and teachers of math and science can increase student achievement in these subjects. Chapter 2 is a review of the literature regarding this subject. This chapter reviews literature about the positive impact of school librarian and teacher collaboration, reasons collaboration may be lacking between school librarians and teachers of math and science, and ways to improve
collaboration with these teachers. The final chapter answers the questions posed in the Chapter 1 and includes conclusions and recommendations regarding the reviewed literature. The end of this paper contains an appendix of online math and science resources.
CHAPTER 2
REVIEW OF THE LITERATURE

Studies have shown that students in the United States score below average in math and science when compared to other countries ("American Kids Don't Add Up" 18). For the past several years, there has been a national push to increase student achievement in science, technology, engineering, and mathematics (STEM) to meet the growing need for advancement in these career fields (Mardis and Payo 9). As the first section of this paper reveals, research supports that collaboration between the school librarian and the classroom teacher increases student achievement ("Schools Libraries Work" 6). The second section of this paper explains why this collaboration is lacking between the school librarian and teachers of math and science. This evidence suggests that both the science and math teachers and the school librarian may be hesitant to collaborate with one another (Mardis, "School Libraries and Science Achievement"). Fortunately, there are ways that school librarians and teachers of math and science can create collaborative relationships to improve student achievement, as the final section reveals.

Collaboration Between School Librarians And Science And Math Teachers

Collaboration between school librarians and teachers of science and math improves students’ success in these subjects ("Schools Libraries Work" 6). This section discusses research that indicates U.S. students are lacking skills in the areas of math and science. It will also explain how collaboration with the school librarian can help improve these skills. Understanding the impact of a school librarian's collaboration with math and science teachers to improve student achievement is the first step to developing a more collaborative relationship. School librarians are information specialists that have an advanced education to support instruction in all subject
areas, including science and math. School librarians can create opportunities to support areas
where students need extra help, primarily in science and math education.

According to the U. S. Department of Education, National Center for Education
Statistics, U.S. students are below average in mathematics and science literacy when compared
to students from other countries ("American Kids Don't Add Up" 18). The National Mathematics
Advisory Panel also states that American students are lagging behind other countries in
mathematical skills, particularly in Algebra ("American Kids Don't Add Up"). The congressional
report “Science, Technology, Engineering, and Mathematics (STEM) Education: Background,
Federal Policy, and Legislative Action” states that there are concerns that the United States is not
preparing enough students to enter STEM fields (Kuenzi 1). When compared to 40 other nations,
15 year-old students in the United States ranked 28th in mathematics and 24th in science (Kuenzi
1). Furthermore, the nation ranks 20th in the proportion of 24 year-olds who receive a science or
engineering degree. This is about 17% of college graduates (2). Kuenzi states that this is
“inconsistent with the nation’s role as a world leader in scientific innovation” (1). The
implementation of legislation and the emphasis on student achievement through standardized
tests has impacted classroom practice (Mardis and Payo 9). "Trends indicate that as long as U.S.
students continue to lag behind students in other nations in science achievement, there will be
mounting pressure to investigate ways to improve student science learning” (Mardis and Payo 9).

Science achievement tends to be higher when librarians and science teachers
collaborate (Mardis and Payo 9). Multiple state studies (Missouri, Texas, Colorado,
Pennsylvania, Alaska, Massachusetts, Iowa, Oregon) have shown that school media centers have
a positive impact on student achievement overall ("School Libraries that Work” 10).
Furthermore, many principles addressed in science literacy are also addressed in information literacy. "Because questioning and the ability to conduct problem-solving processes are essential to science learning, school library media specialists can support science learning through teaching students information literacy and research skills" (Mardis, "Science-Related Topics, 3). In a comparison of standards, the AASL Standards for the 21st Century Learner define similar inquiry standards to those taught in science. AASL standards state students are to use an inquiry-based process to find information, determine the accuracy of information, identify different points of view, and make sense of information (n.p.). Students can become efficient in science when information literacy skills are incorporated (Ercegovac 52). By defining similarities between science and information literacy standards, they can be incorporated into the library:

For example, the National Science Education Standards, which define the standards that science teachers must follow, say students must describe, explain, and predict natural phenomena; understand articles about science; debate opposite sides of scientific issues; and evaluate the quality of scientific information. It sounds a lot like what's expected of media specialists-to create information literate students who can access, find, and evaluate information from multiple sources (52).

Reasons Math and Science Teachers do not Collaborate with School Librarians

There are several obstacles preventing collaboration from both the math and science classroom teachers and the school librarians. These reasons include a lack of professional reading for librarians about collaboration with math and science teachers and a lack of pre-service training for the classroom teacher in collaboration with the school librarian. Furthermore,
math and science teachers may not be aware of the resources available in the library. Also, many school librarians report discomfort with their own math and science knowledge.

In a 2002 study by Weaver, 68% of librarians ranked professional reading as very important and a total of 98% ranked it from somewhat to very important (2). According to this same study, more than half of librarians read 3-5 professional journals each month (Weaver 2). Mardis analyzed popular school library periodicals to determine the percentage of articles that addressed the science content area. Less than 5% of articles addressed this area and few articles offered suggestions to develop an in-depth collaborative relationship with the science teacher ("School Libraries and Science Achievement"). When science topics are addressed, they usually consist of reviews of books, videos, or products. Only about one third of the articles relating to science provide methods or suggestions to improve collaboration with science teachers ("Science-Related Topics" 12). The lack of professional reading for librarians in the subjects of science and math obscures the need for librarians to promote these subjects and collaborate with these teachers.

An additional obstacle of collaboration between the school librarian and science teachers is that science is often a difficult field for school librarians (Mardis, "Science-Related Topics" 4). A lack of opportunities for professional development in science and library collaboration, and little undergraduate and graduate coursework in the sciences create a feeling of inadequacy related to collaboration with science teachers ("School Libraries and Science Achievement"). Mardis surveyed school librarians regarding their comfort and knowledge of science concepts and standards ("Science-Related Topics" 2). Most surveyed school librarians reported that they have an undergraduate background in the humanities and most of the coursework in graduate
library science classes focused on the humanities (4). David Barr, a director of the 21st Century Information Fluency project of the Illinois Math and Science Academy agrees. He states that librarians are mostly English and social science majors and may not be comfortable with math and science (qtd. in Minkel 28). In a survey of school librarians conducted by Mardis, few respondents had a background in a science field ("School Libraries and Science Achievement" n.p.). Furthermore, even school librarians with a science background begin to lose the connection to the sciences as their career progresses (n.p.). One respondent illustrated this by writing, "I had a biology major and enjoyed three years as a medical librarian. While I'm comfortable with the vocabulary of science, all that experience was many years ago and I don't think it is much help in understanding the scope and sequence of my new middle school's science curriculum" (n.p.). The lack of familiarity with science and math content and standards may cause school librarians to be hesitant to approach math and science teachers. Librarian discomfort with their science knowledge can also extend into a lagging development of the library collection in the sciences (Mardis and Payo 11). This can lead to a weak and outdated science and math collection.

Math and science teachers often do not approach the school librarian for assistance, especially when using technology (Minkel 28). Some school librarians have found it difficult for math teachers to be interested in using the school library. Gardner, a high school librarian in Lebanon, Pennsylvania, states that math teachers want to be in control of their own environment and feel solely responsible for teaching math content (26). Shultz-Jones and Ledbetter find that although many library literacy goals and science literacy goals coincide, collaboration does not often take place (23). In this 2008 study, they found the biggest factors affecting a lack of collaboration included science and math teachers’ concerns regarding the school librarian's
credibility and a lack of awareness of how the media specialist can positively affect student achievement (36). A major contributing factor to a lack of awareness of developing a collaborative relationship includes the pre-service experience (24). According to Schultz-Jones and Ledbetter, while pre-service teachers are expected to know how to use the library, they lack instruction in methods of collaboration with school librarians (24). Because pre-service teachers are not prepared to collaborate with school librarians, they have not identified the service that librarians can provide (25). Furthermore, new teachers may also be unlikely to collaborate because they are focusing on control of their classroom rather than developing collaborative relationships (Mardis and Payo 10).

**Developing a collaborative relationship with science and math teachers**

School librarians can develop a collaborative relationship with math and science teachers despite obstacles. Developing a collection that emphasizes math and science standards will serve teachers' and students' needs. Attending curriculum meetings to know math and science standards and to discover resources that teachers will find useful will help build the library collection. The school librarian can then promote and share these resources with teachers and students. Furthermore, increasing professional development opportunities geared toward math and science teachers can promote the librarian as a teaching resource. This can lead to developing in-depth collaborative projects with math and science teachers.

Mardis and Payo state that a library program that is committed to ongoing attention to build a current and extensive science collection improves student achievement (8). Student science achievement tends to be higher when librarians and science teachers collaborate to build a rich multimedia collection in the school library (Mardis and Payo 13). Duff recommends that
the school librarian ask science and math teachers for resource recommendations and add these resources in their book orders to build a strong collection that will be utilized by science and math teachers and students (25).

Using knowledge of science and math standards to build the library collection will support that curriculum (Pandora 23). Serving on science and math curriculum committees and attending department meetings will help school librarians become more familiar with science and math standards (Valentine 38). Knowledge of these standards will enable the school librarian to identify and demonstrate helpful websites and showcase print and digital resources to promote the library to science and math teachers (Minkel 29).

There are many books and printed materials that can be included in the library collection to support the mathematics and science standards. The National Council of Teachers of English and the National Council of Teachers of Mathematics agree that cross-curricular reading enriches content knowledge (Wallace 26). Wallace identifies three types of books that can be used to teach math content (26). These include informational trade books, young adult literature, and environmental print.

Informational trade books are nonfiction books written about mathematical subjects. They are not written for math curriculum but include topics such as the history of mathematics, famous mathematicians, and mathematical concepts (Wallace 26). Books such as Why Pi? by Johnny Ball, Odd Boy Out: Young Albert Einstein by Don Brown and The Secret Life of Math: Discover How (and Why) Numbers Have Survived From the Cave Dwellers to Us by Anne McCullum are written for elementary students and up (Brennan). The Joy of X: A Guided Tour of
Math From One to Infinity by Steven Strogatz teaches older students about math concepts in a collection of essays (Weisman 44).

Young adult literature includes fictional books that address a mathematical concept. Wallace provides the example of the Scott Westerfeld fantasy series, The Midnighters, in which multiples of the number 13 are significant (26). Preschool through first grade students can learn about patterns using Two Sticks by Orel Protopopescu, Over in the Ocean by Marianne Berkes and Jonathan and His Mommy by Irene Small (Bautz 50). The Sir Cumference series of books by Cindy Neuschwanderv, written for grades four and up, introduce students to geometry concepts (Brennan). Students can learn about math concepts with books such as Zero the Hero by Joan Holub and Edgar Allan Poe’s Pie: Math Puzzlers in Classic Poems by J. Patrick Lewis (Weisman 42-43). There are also books available that have ready-to-use lesson plans using literature in mathematics. One such book is Math Links: Teaching the NCTM 2000 Standards Through Children’s Literature by Evans, Leiija, and Falkner which provides lessons using picture books to teach math for Kindergarten through 3rd grade.

Environmental print can provide students with connections to real-life mathematical data. Print from advertisements, catalogs, newspapers, and e-mail spam can be used to help students connect mathematical reasoning skills to their everyday life (Wallace 26). For example, students may use grocery advertisements to create a food budget for a week using mathematics standards. In addition to the resources mentioned by Wallace, the Library of Congress Website and the American Memories Collection contains several resources that may be used to teach mathematics using environmental print (Petri 10). Archived architectural drawings, advertisements, 19th century textbooks, and statistics can be located on this website and used to
create collaborative projects between the school librarian and the science or mathematics classroom teacher.

There is an abundance of valuable science and math information and resources online. School librarians can showcase these online resources on the library website (Minkel 29). The librarian can also create pathfinders to provide access to online resources that science and math teachers use or find helpful for their students. This will provide the opportunity for science and math teachers to easily share their resources with one another and their students. Helpful websites that offer student tutorials about math concepts such as Kahn Academy (https://www.khanacademy.org/library) and Purplemath (http://www.purplemath.com/modules/index.htm) can be included on pathfinders as well as STEM career information from websites such as the Occupational Outlook Handbook (http://www.bls.gov/oco/) and Fun Works digital library (http://thefunworks.edc.org).

Mardis and Payo recommend that the school librarian be knowledgeable about The National Science, Technology, Engineering, and Mathematics Education Digital Library (NSDL), a national online library that offers resources for education and research (www.nsdl.org). The NSDL provides access to interactive learning activities and materials. Teachers and students are able to visit virtual labs and use real-time data, as well as find journal articles (Mardis and Payo 11). This digital library contains useful sites that can be used in the math and science classrooms. (See Appendix A for a description of additional digital resources.)

Schultz-Jones and Ledbetter recommend that the school librarian be visible in order to develop a more collaborative relationship with science and math teachers (38). School librarians create awareness of their availability and willingness to collaborate with science and math
teachers. They promote their services and available resources that support science and math curriculum. The first step to create a collaborative relationship is to let teachers know the librarian is there to support the curriculum and to find opportunities to promote resources to them. The school librarian can attend department meetings and receive input from teachers to be informed of upcoming units of study to identify resources that will be useful. By creating a “traveling library,” the school librarian can take STEM resources to the science and math classrooms (Duff 27).

While the development of a rich STEM library collection is necessary, it is just as important to promote it. To draw attention to the science and math sections of the library, Duff suggests making specific signs in Dewey areas in the 500s and 600s of the reference and nonfiction sections to highlight math and science subjects (25). Creating book and magazine displays that promote STEM and asking science and math teachers to provide samples of projects to display in the library can also promote math and science in the school library (25). For example, a bulletin board that highlights the 510s (mathematics) may be created by cutting out math symbols. Highlighting titles on a bulletin board or in book displays and posting problems that offer prizes for correct solutions also promotes mathematics in the library (Curriculum Connections 23). To further promote science and math in the library, the school librarian can invite science and math classes to a “STEM Library Orientation” which highlights available STEM resources including fiction and nonfiction books, magazines, databases, websites, displays, and programs (Duff 26). The librarian can also present STEM book talks and invite guest speakers and authors to the library that work in the STEM fields. Duff further suggests adding a “STEM Highlights” section to the library newsletter, website, or bulletin board.
(27). By promoting a strong STEM presence in the library, science and math teachers and students will become aware of the support that the library and librarian provide in these subject areas.

Increasing professional development opportunities and participation can build both confidence and opportunities for school librarians and math and science teachers to collaborate. In the Information Fluency project, Illinois math and science teachers and school librarians participate in workshops to create lessons which address information literacy standards and math and science standards (Minkel 28). Gardner facilitates professional development with science and math teachers to integrate technology into lessons and design technology-based projects. The created projects align with both curriculum standards and information literacy standards (26). School librarians can also provide training in presentation software, interactive whiteboards, student response systems, and other new equipment that can enrich science and math instruction practices. They can model best practices and save the teacher time by introducing them to online STEM resources (Pandora 23).

There are many unique projects where math and science teachers may find collaboration with the school librarian helpful, and the skills and knowledge of the school librarian beneficial. Pandora suggests starting a small pilot program partnering with willing science and math teachers to create interdisciplinary lessons and projects. These lessons or projects can then be presented to the entire science or math department (24). There are also projects which partner school libraries with public libraries to improve math and science skills. One such program in Dade County, Florida, allows students to come to the public library on Saturday mornings for
hands-on science and math activities taught by public and school librarians and content area teachers (Valentine 38).

Additional collaborative project based learning opportunities that math or science teachers have found enriched by school librarians include one based on CSI. Another project is called UBUYACAR. Then there are school garden projects that benefit from the availability of information resources. There are citizen science projects, such as a migratory birds project, that engage students using science curriculum and library resources.

The popularity of the television series CSI has affected many science classes. As many as 77% of middle school and high school science teachers have reported using forensics to engage students and teach scientific concepts (Mardis “It's Not Just Whodunnit” 12). Forensic study can offer a chance for collaboration between the science teacher and librarian. The library is often one of the largest rooms in a school so it can be set up as a forensic crime scene. The offer of the library space can be an effective way to entice a science teacher to collaborate. The librarian can work collaboratively with the science teacher by suggesting supporting resources such as digital libraries and databases and by teaching information literacy skills to students so that they are successful when working on a forensics project.

UBUYACAR is a project based learning activity where students must determine how much they need their annual salary to be to afford the car that they would like (Troutner 40). This site provides a student manual and suggested resources to complete the project. The school librarian can help students find additional resources for this project.

Planning and creating a school garden is an effective way to create a collaborative relationship with a science teacher. Research shows that a school garden can raise science
achievement scores (Mackey and Stewart 34). The school librarian can find resources, such as partnering organizations and digital resources, and work with teachers and students in developing a plan for the garden. The librarian can assist students in researching what types of plants would be good to grow in the garden and in using multimedia to create a blueprint of the garden and garden labels (35).

Citizen science projects can also be engaging for students. Studies suggest that students are interested in the environment and participating in activities to help protect it (Mardis "You've Got the Hook" 11). Citizen science projects helps students connect with the environment, learn science, use technology, and provide data for further scientific research. In these projects, students collect ecological samples and participate in real-world scientific inquiry projects (12). For example, students can participate in the Neighborhood Nestwatch program where they locate, observe, and compare bird nests in urban, suburban, and rural environments. The results of student data from citizen science projects have provided information about topics such as West Nile Virus, lead contamination, and nest predation. The information technology skills that are needed to complete these projects provide collaborative opportunities for the classroom science teacher and the librarian.

Knowledge of math and science standards is necessary to build a strong math and science library collection. By attending curriculum and department meetings, a school librarian can discover these standards and learn of upcoming units of study. The school librarian can promote resources that will support these standards. Increasing professional development opportunities with math and science teachers may lead to in-depth collaborative projects.
Collaboration between math and science teachers and school librarians increases student achievement (School Libraries Work 6). Studies indicate that students in the United States are lacking preparation to enter STEM fields (Kuenzi 1). Despite obstacles preventing collaboration, school librarians can collaborate with math and science teachers to increase student achievement.
CHAPTER 3
CONCLUSION

Although research suggests that collaboration between classroom teachers and school librarians raises student achievement, evidence suggests that collaboration is lacking between math and science teachers and the school librarian. This paper examines the questions surrounding this issue, including how the librarian can begin building a collaborative relationship with math and science teachers. This paper provided research and answered the following questions: Why is collaboration necessary between school librarians and math and science content teachers? What reasons do math and science teachers have to not collaborate with school librarians and vice versa? How can school librarians move toward a collaborative relationship with math and science teachers?

The Necessity of Collaboration

Many students in the United States are lacking math and science skills when compared to other developed countries. With a current national push to increase careers in science, technology, engineering, and mathematics (STEM) areas, increasing student achievement in science and math is crucial. Currently, research suggests school librarians collaborate little with science and math teachers. One way to increase student achievement in the math and science content areas is to increase this collaboration.

Studies indicate student achievement is raised when school librarians and teachers of science and math collaborate. School librarians are information specialists educated to collaborate with teachers to increase student achievement. Furthermore, school librarians can identify similarities between information literacy standards and math and science state standards.
By working together, science and math programs and the school library program can mutually benefit each other and, more importantly, improve student achievement.

**Reasons Math and Science Teachers do not Collaborate**

Both math and science teachers and school librarians are often hesitant to collaborate. School librarians may feel they have a lack of content knowledge about math and science especially since an overwhelming number of them have a background in the humanities. Librarians may not feel comfortable in their knowledge of the curriculum and the standards in these subjects. School librarians may feel they are unable to address these standards within the library even though there is overlap among science and math content standards and AASL 21st Century Learner Standards. Professional reading in science and math is often scarce in school library journals so many librarians may not feel or be aware that it is an area that needs growth. Professional development opportunities for school librarians and teachers of science and math regarding how to increase collaboration are also scarce.

Classroom teachers often lack pre-service training in building collaborative relationships with the school librarian. Many are unaware of how the school librarian can help them increase student achievement and, in general, are unaware of the role of school librarians. Science and math teachers may be open when approached with an offer to collaborate but have never considered asking the school librarian for help. They may see the role of the school librarian as someone who is there to support and teach students rather than someone who is a collaborative instructional partner.
Developing a Collaborative Relationship

In order to effectively find and share resources for math and science teachers, school librarians familiarize themselves with the standards addressed in these content areas. School librarians can be members of math and science curriculum committees to be knowledgeable about state standards and collaborate with teachers about useful resources. By knowing these content standards, the school librarian can create a school library that emphasizes STEM print and digital resources and promotes science and math. Resources, such as the National Science Digital Library, can provide free curriculum support to the classroom teacher. The school librarian can provide access to additional online resources and websites by creating a pathfinder to share with teachers. The creation of pathfinders to provide easy access to these online resources benefits teachers and students. Printed materials including informational trade books, fiction, and environmental print can also be effective tools to teach science and math. Researching, purchasing, and promoting literature with science and math teachers and students increases student interest and achievement in the subjects.

Opening the door by providing math and science teachers with resources for their classroom can be the start of a collaborative relationship. School librarians create a library that promotes science and math resources so that teachers and students understand the connection between the library and these subjects. The librarian can highlight STEM resources using Dewey signage, newsletters, and library displays such as bulletin boards and student work samples. Furthermore, a “STEM Library Orientation” can be used to share with students and teachers the library resources that are available. The creation of a STEM presence in a school library
increases awareness of the support that the librarian can provide to math and science teachers and students.

An increase in professional development opportunities between school librarians and math and science teachers can also lead to a collaborative relationship. Through professional development, teachers and school librarians collaborate to prepare projects that are aligned with information literacy standards and content standards. Furthermore, the school librarian provides training in digital resources and tools that can be used to enrich student knowledge and achievement.
WORKS CITED


Appendix A: Online Resources for Science and Mathematics

The following includes a list of online resources that a school librarian may share with math and science teachers and students. The list is separated by math and science subjects and then by resources that combine math and science. These resources are all available free of charge.

Math Resources:

- Drexel’s Math Forum (http://mathforum.org) is a large online source for the study of mathematics. Teachers can find and share resources, math applets, and lesson plans. Students can use the site to ask questions and study math concepts.
- Kaiddy.com (www.kaidy.com) contains free puzzles to download and creates math manipulatives for students.
- The National Library of Virtual Manipulatives (http://nlvm.usu.edu/en/nav/vlibrary.html) contains math manipulatives and interactive activities. Teachers can also share lesson plans.
- Purplemath (http://www.purplemath.com/modules/index.htm) provides students with step by step lessons on most concepts for pre-algebra through trigonometry.

Science Resources:

- The American Association for the Advancement of Science: Education and Human Resources (ehrweb.aaas.org/SchTeachLib), a scientific association in the United States, has a “Schools, Teachers, and Librarians” page.
• The Cornell Lab of Ornithology (www.birds.cornell.edu) is a digital library focused on the study of birds. Students and teachers can listen to bird sounds and view images. The site also offers BirdSleuth, a free curriculum guide and lesson plans for K-12 grades with links to national standards. Students can participate in project-based learning by collecting and sharing data about birds on the site.

• The eSkeletons Project (www.eskeletons.org) from the University of Texas at Austin provides virtual access to primate bones. Students can compare primate skeletons, manipulate bones, and even measure bone length using this site. This is a way to study diverse bones that students may not otherwise be able to.

• MIT’s Technology Review (www.technologyreview.com) is a science and technology news resource.

• Optics for Kids (www.opticsforkids.com) provided by the Optical Society of America contains engaging activities related to the study of light.

• The Scientist (www.the-scientist.com) is recommended for high school students to keep up with news about the life sciences.

Science and Math Resources

• The Fun Works digital library (http://thefunworks.edc.org) is an interactive website that students can use to identify their strengths and find interesting professions in the math and science fields. The site provides links for further career investigations as well as games to explore career interests.

• Learning Express Library, a free resource available to MOREnet members, provides standardized testing practice including for the ACT, SAT, and AP exams.
By using the online version of the Occupational Outlook Handbook (http://www.bls.gov/oco/) students can research how math and science may be needed in career fields which they find interesting ("Math at Work" 14). This handbook is published by the Bureau of Labor Statistics.