School Libraries and Science Achievement: A View from Michigan's Middle Schools

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If strong school library media centers (SLMCs) positively impact middle school student reading achievement, as measured on standardized tests, are they also beneficial for middle school science achievement? To answer this question, the researcher built upon the statistical analyses used in previous school library impact studies with qualitative measures in an attempt to discover relationships between science education and school library media programs. Taking into account major external predictors of student achievement, the researcher examined usage, staffing, collection, technology, and budgetary school library media program variables. She found that 2002 eighth-grade Michigan Educational Assessment Program (MEAP) science test scores had a significant positive relationship only with the size of the SLMC video collection. In subsequent qualitative follow-up activity, participants emphasized the importance of providing video in their services to science educators, as well as their challenges in providing high-quality, current science collections. Participants also pointed to teacher collaboration as a primary but underutilized way of improving their link with science teachers. The results of this study imply that while school library media specialists ably furnish science teachers and students with multimedia resources, due to systemic and professional factors, they are not yet consistently and confidently poised to be science collaborators.

Prologue

I would like to begin this formal research report with a personal recollection from my first job as a full-time media specialist. The school, a parochial high school for boys, had always had a librarian on staff, but the administration was thrilled to be able to tell prospective parents that they had a state-certified school library media specialist. After the school year got underway, my days were filled with helping students with their homework, processing new materials, and taking care of the audiovisual equipment. After school, I took the videotaping requests from the science teachers for off-air recordings from public and cable television. Each morning, I retrieved the recorded tapes and apportioned them to our fleet of TV/VCR carts. I pushed the carts down the hall into the science wing and deposited them just inside the doors of the classrooms. Later, I returned to pick up the carts and any request forms for the next day's tapings. I never knew what concepts the teachers taught with the recordings and rarely was asked to provide materials beyond the video cassettes.

I relate this scenario not to illustrate a situation of underuse of a school library media specialist, but to ask you to keep this experience, deeply embedded in my professional memory, in mind as you read this research report. As you will see in the results of this study, the past is, quite literally, prologue.

Introduction

In many ways, science classrooms and school library media centers (SLMCs) are parallel universes, struggling with their own reform issues and with documenting their own positive impacts on student learning. As the trend toward data-driven decision-making and practice grows in the school setting, it is increasingly important for every component of the learning environment to have demonstrable effect and to be mutually reinforcing. Yet, science reformers do not seem to recognize the potential for school library media specialists to support their efforts (Lanahan 2002), nor do school library media practitioners and researchers seem to be focusing on efforts to build relationships with science educators (Abilock 2003).

Background and Literature Review

Now is a critical time in the reform of teaching science to K-12 students in the United States, as the federal No Child Left Behind (NCLB) education legislation is being deployed, with its emphases on teacher quality, administrative accountability, evidence-based practices, and student achievement measured through standardized tests. These mandated tests, to be administered annually with high-stakes outcomes for schools, are expected to have a dramatic impact on classroom practice in science, where such testing is required in 2007-08 (Cavanagh 2004). While outcomes of such testing on teaching and learning are debated, NCLB requirements will result in significant changes in the nation's schools as the legislation is implemented in full. As long as American students continue to lag behind other nations in science achievement (Gonzalez et al. 2004), undoubtedly there will mounting be pressure to improve achievement in this area.

Researchers from the Library Research Service established a link between strong school library media programs and reading achievement in Colorado in 1993 and in 2000 (Lance, Rodney, and Hamilton-Pennell 2000a; Lance, Welborn, and Hamilton-Pennell 1993). The Michigan School Library Study (MSLS), conducted by the same researchers, replicated and confirmed earlier conclusions (Rodney, Lance, and Hamilton-Pennell 2003). However, reading test scores may only be part of academic achievement affected by strong school library media programs. The effect of strong school library media programs on science achievement is largely unreported.

The (Lack Of) Connection between School Libraries and Science Education

The absence of connection between school library media specialists and science educators may be a bidirectional problem. School library media specialists often lack the personal content knowledge and resource base necessary to confidently engage science educators (Mardis 2005). In addition, school library media practitioner literature rarely addresses science-related topics and does not provide an informal means for school library media specialists to gain currency on science-related topics or resources. While leading publications do contain a number of articles emphasizing the importance of collaboration in general, fewer than 5 percent of articles published between 1998 and 2004 were devoted to any aspect of working with science teachers or students (Mardis 2006). This dearth of subject matter in not likely the result of intentional editorial exclusion; it is more likely symptomatic of a lack of dialogue between school library media specialists and science educators (Mardis 2005).

Science teachers rely heavily upon peers and professional development activities to gain information about new curriculum resources and strategies (Hanson and Carlson 2005; Williams and Coles 2003). When they are enacting instructional activities, they rely mainly on textbooks, Web sites used within their classrooms, and materials from their classroom collections (Hanson and Carlson 2005; Stern and Roseman 2004). Science teachers experience much isolation in their practice (Schlichte, Yssel, and Merbler 2005; Tobin and Roth 2005; Weld 1998), with many of them teaching out-of-field, and, perhaps as a consequence, are plagued by persistent rates of attrition and shortage (National Science Foundation [NSF] 2006). Another complicating aspect of the science teaching and its suitability for school library collaboration is the prevalence of new teachers (NSF 2006). New and early career science teachers often are still developing their sense of instructional (Settlage 2004) and content-area (Dennick and Joyes 1994) mastery, as well as establishing control in the classroom (Hensley 2002); they are less likely to reach out and form collaborative and collegial relationships outside their departments until they gain confidence in all aspects of their practice.

The Suitability of School Libraries for Science Learning

Many middle school students feel that learning science with the aid of a variety of resources, such as those found in the school library, is very important. Multimodal learning (that is, learning through a variety of textual, electronic, digital, and physical media) helps to build essential prior knowledge, the platform upon which subsequent learning takes place (Bransford, Brown, and Cocking 2000; Hirsch 2006; Roschelle 1995). Moreover, the increasing prevalence of English language learners in all schools presents a challenge to classroom-based science instruction (Lee 2005). When students who lack English language proficiency are encouraged to learn science in a hands-on, resource-based, inquiry environment, they show improvements in all aspects of their academic and communication skills (Lee 2005).

For some students, learning how to respond to an inquiry-based, active environment is not part of their early classroom experience. The types of hands-on, multimodal learning that can take place in the elementary media center during group activities can build the creative, open thinking required to thrive in inquiry-based situations. In Bolliger's (2006) study, which utilized classroom observation and written student feedback, students made clear that their preferred learning environments were very active but that they perceived barriers to engaging in them. Barriers included many students feeling that they had not experienced enough unstructured learning environments to make smooth transitions into inquiry-based learning. They pointed to the need for more socializing, more group work, and more exposure to a variety of learning tools and resources as important ways to respond to that barrier. Helping students to understand that the school library is a means of access to those tools by increasing their active learning opportunities can spark the creativity and imagination that is the key to sustained student achievement (Bush 2006).

As the research presented here suggests, barriers to collaboration between science teachers and school library media specialists are possibly as much human issues as structural impediments. To explore these barriers and uncover links to student success, this paper describes a research study completed in late 2004 in which the researcher examined the relationship between school library media programs and science achievement in eighth-grade students from Michigan. This paper reports the results of the mixed-method sequential explanatory study undertaken to uncover the connection between school library media programs and science achievement, as well as the factors present in the relationships between school library media specialists and science teachers that encourage student achievement on state-mandated standardized tests.

Statement of the Problem

If strong SLMCs positively impact middle school student reading achievement, do they also have positive relationships with middle school science achievement? The 2002 MSLS showed that school library media specialists' support, qualifications, and facilities played essential roles in promoting student reading achievement (Rodney, Lance, and Hamilton-Pennell 2003); many of the questions that led to these conclusions may be asked about the effect of school library media programs on science achievement. Research questions addressed in this study included:

- How is the relationship between school library media programs and reading achievement similar to the relationship between school library media programs and science achievement?
- What are the characteristics of school library media specialists and school library programs that influence the relationship to science achievement?
- In what ways do school library media specialists think that yearly testing in science and other systemic pressures will affect their relationship with science educators and students?
- What factors do school library media specialists identify as key to effective interactions with science teachers and students?

Methods

To address the research questions, the researcher designed a study that built upon the statistical analyses used in the MSLS with qualitative measures in an attempt to discover perceived relationships between science education and school library media programs. The research reported here embodied a sequential explanatory mixed-method approach using qualitative techniques in an effort to explain initial quantitative analyses.

First, quantitative data composed of the original MSLS data set and 2001 eighth-grade Michigan Evaluation of Academic Progress (MEAP) state-administered and mandated science test scores were collected and analyzed. The researcher used bivariate correlations to identify variables from the MSLS survey that had significant correlations with eighth-grade MEAP science scores. She clustered significant variables according to their MSLS survey section, which were then used in multiple regression analyses with the predominant external predictive factors of science achievement, percent of school students eligible for the United States' National School Lunch Program (NSLP), and school district per pupil expenditure (DPPE). These two variables are considered indicators of poverty in the United States.

It should be noted that the original MSLS data set was comprised of survey results; MEAP scores; and demographic, funding, and census data from state and national sources. To draw the most definitive conclusions about the true linearity of the bivariate correlations, the researcher felt that the data should represent normal distribution and a truly random sample, as based on recommendations from Green and Salkind (2005). The survey data were not necessarily random, because every school in Michigan received a survey and the distribution of the respondents' key academic, community, and economic variables was not normal. As a check on these concerns, the researcher employed a mixed method design.

This mixed method research design was selected to enhance the interpretation of the correlation results. While the correlation would undoubtedly be effective at highlighting which school library media program variables related strongly to student achievement in science, the qualitative follow-up was intended to give insight into why and how the particular variables were important for student learning in science. In this study, a sequential, mixed-method approach was used to explain the qualitative results, especially the unexpected findings, of the quantitative analyses (Creswell 2003).

Qualitative data were collected to illuminate the findings of the correlational analyses. An e-mail discussion group of eleven school library media specialists from across Michigan reviewed, reflected upon, and responded to questions about their interactions with science learning and teaching resources, science teachers, and science students.

Description of Data Sets and Samples

The quantitative data used in the present study were primarily drawn from the middle school portion of the data set used in MSLS. The original MSLS data were comprised of the results of surveys sent to school library media specialist s in Michigan public schools in 2001 that recorded 114 aspects of school library media programs. Added to these results were community, district, and school data for each school that returned a survey. The original MSLS data set also included 2001 MEAP reading scores for the tested grades (fourth and seventh). The MEAP science test is given in fifth grade and eighth grade.

The researcher limited the data set to include only schools that served both seventh- and eighth-grade students because those two grades would likely share the same school library media specialist and have dedicated science classes. Ultimately, the sample used in the present study included 196 schools. The researcher appended the data for the 196 schools with 2001 MEAP science test scores.

The schools in the sample were predominantly in Michigan's lower peninsula; the largest numbers of schools were in Wayne and Oakland counties, the two most populated in the state (U.S. Census Bureau 2005). Table 1 gives an overview of community, district, and school data about the schools in the sample. The means and medians were relatively similar for each variable, indicating similarity among the schools included in the sample. While it is difficult to assess the relative wealth of the communities included in the sample by average salary because the data do not reflect the total number of wage earners per household, other factors, such as the percent of high school graduates in the community, the percent of students eligible for NSLP, and the DPPE, generally suggest that the schools in the sample are in middle-class communities with low (about 19 percent) minority enrollment and low (five students to one teacher) pupil-teacher ratios. This data presented in this table clearly called for the methodological caution the researcher addressed in the methodology section above. The participants' distribution was neither normal nor randomly selected.

Examining descriptive data for selected variables in the data set gave the researcher a picture of the average school library media program captured in the survey responses. These descriptive data are presented in table 2. These data give an overall picture of the survey respondents' SLMCs as well-resourced, with mean collection sizes of 9,878 volumes, a large number (231) of videos, and many periodical subscriptions. The sample SLMCsare staffed an average of fifty-eight hours per week, although they are not always staffed by a full-time, credentialed school library media specialist.

When the credentialed school library media specialist was in the SLMC, this person split time among a variety of activities. The average survey respondent worked closely with teachers, spending almost five hours per typical week cooperatively instructing students, four hours per week identifying materials with teachers, and two hours per week providing in-service training. Given that the SLMC received an average of twenty-one class visits and school library media specialists tended to interact with almost three hundred students in a typical week, the average split-appointment school library media specialist worked busily and independently each week.

Although budgets showed a wide variance, the average school library media program had about $8,000 of annual operating expenditures. These expenditures covered the large number of computers in the library, subscriptions to online databases and periodicals, and the development of large print and video collections.

The qualitative data presented here were obtained from an e-mail focus group composed of eleven school library media specialists with an average of thirteen years of service. Ten of the school library media specialists served students in seventh and eighth grades; one school library media specialist served ninth through twelfth grades but had previously worked in a school that served eighth-graders. Of the discussion group members, five school library media specialists worked in suburban schools, five worked in rural schools, and one worked in an urban school. All of the school library media specialists answered all of the discussion questions posed by the researcher.

Summary of Results

The results of the two data-gathering approaches are presented in two separate sections, quantitative results and qualitative results.

Quantitative Results

Two statistical approaches were used to analyze quantitative data: bivariate correlation and multiple linear regression. The results of these analyses are presented below.

Bivariate Correlations

In this study, reading and science MEAP scores were individually paired with the 117 numeric variables gathered with the MSLS surveys. Results of the Pearson's product-moment (PPM) correlation tests are given in tabular format. Due to the large number of variables examined, the PPM test results are condensed and summarized into two tables: a table that shows significant positive correlations, and a table that shows negative correlations. Interpretations and analyses of the tables are provided. Each table reports five items:

5. The first column of each correlation table identifies which SLMC variable is being paired with seventh-grade reading MEAP test scores and eighth-grade science MEAP scores.
6. The second column of the table reports n1, or the number of survey responses from school library media specialists who serve seventh graders.
7. The third column of the table reports r1, the correlation coefficient relative to the seventh grade reading scores.
8. The fourth column of the table reports n2, or the number of survey responses from school library media specialists who serve eighth graders.
9. The fifth column of the table reports r2, or the correlation coefficient relative to eighth grade science MEAP test scores.

Positive Correlations

SLMC variables have some notable positive relationships with MEAP science scores. Table 3 displays the library variables with a significant positive correlation to eighth-grade science scores. Correlations for seventh-grade MEAP reading scores are provided for comparison. The variables are listed in descending order based on correlation to science scores.

As table 4 depicts, factors relating to school library staffing and access demonstrated the highest correlations of the variables examined, with the "total number of paid staff" variable in the SLMC correlating highest to science scores, while the "weekly availability of a credentialed school library media specialist " variable correlated highest to reading scores. "Paid staff hours per week" and the "number of credentialed school library media specialist" available to students also were significant correlations.

The amount that the SLMC staff was active in performing all of their job duties correlated highly to student achievement in both reading and science. Technology also had a notable presence, with "computers under library supervision" and "computers elsewhere in the school" among the highest correlating variables. The "availability of flexibly scheduled staffed hours" variable and, correspondingly, variables that reflected the ability for classes and groups to visit the SLMC, had significant relationships to student test scores in reading and science.

The video and book contents of the SLMC collection also correlated with reading and science scores in a significant way.

Negative Correlations

A number of variables measured by the survey showed negative correlations to MEAP reading and science scores. Table 4 lists the negative correlations in ascending order of correlation to science score. Although none of the variables demonstrate a significant negative correlation to student achievement, they are reported because they may have policy implications for school libraries.

Staffing issues comprise the majority of negatively correlated variables. The presence of school library staff with credentials other than those of a school library media specialist (in Michigan, full credentials include a master's degree in library science and teacher certification with school library endorsement) negatively correlate to science, and in many cases, reading scores. The hours per week these individuals staff the SLMC also have a negative relationship to student achievement in most instances measured. Individual student use of materials in the library has a negative relationship to student achievement, as do the hours per week that the SLMC staff meet with principals or other building and district administrators. Finally, weekly summer library hours seem to have no relationship to student achievement in science, but a negative relationship to reading test scores.

Multiple Regressions

The significant, positively correlating variables in table 3 were grouped into clusters: service hours; paid staff; paid staff hours; staff activities (in hours); school library media specialist usage, computers in SLMC; computers (elsewhere) in school; collection; and expenditures; these clusters are depicted in figure 1.

The goal of the multiple regression analyses was to identify combinations of school library media program variables that have a relationship to student achievement in science. Multiple regressions with two ordered sets of predictors were performed using science scores as the dependent variables and dominant achievement variables and the clusters described in the previous section as independent variables.

The first step of multiple regressions was to identify major variables that most highly correlate with MEAP science achievement. First, regression analyses, including data on the percent of students eligible for the NSLP and the DPPE, were conducted to determine the extent to which these typical dominant predictors of academic achievement were associated with science achievement. Other variables considered--the percent of students from select minority groups, percent of community's adult population who graduated from high school, number of library volumes per student, library expenditures per student, and teacher-pupil ratio--were ultimately excluded from the analyses because they did not account for a significant amount of additional test score variation.

For eighth-grade MEAP science scores, the regression equation of the predominant predictive factors was significant, with $R2=.402$, adjusted $R2=.395$, $F (2,176)=59.071$, $p=.01$. NSLP eligibility and DPPE accounted for almost 40 percent of the variation in scores on the eighth-grade MEAP science test.

Subsequent regression analyses were conducted to determine the extent to which the school library variables with the highest correlations offset the remaining 60 percent of variability in student achievement in science.

The "staffing and access," "computers in school," and "computers in library" clusters accounted for no significant change to the amount of variance in MEAP science scores. As a check on this conclusion, the significance of the partial correlations for each variable in the cluster was inspected. None of the variables in any cluster demonstrated a significant correlation to science scores when the dominant predictors were taken into account.

In the "collection" cluster, the variables, "videos per one hundred students" and "books of any type per one hundred students," accounted for a significant proportion of the science achievement variance after considering for the effects of NSLP eligibility and DPPE, with R2 change =.020, $F (2,160)$, $p\leq 05$. These results suggest that school libraries with strong video and print collections benefit science achievement.

A closer inspection of the partial correlations for the "collection" cluster revealed that while the "videos per one hundred students" variable had a significant contribution to the prediction equation, $t = 2.349$, $p \leq .05$, the "books of any type per one hundred students" variable did not. The "videos per one hundred students" variable alone accounted for 2 percent of the remaining approximately 60 percent of science achievement; while the correlation is not strong, this percentage denotes a significant correlation to science achievement when the major external predictors are taken into account.

Qualitative Results

The e-mail discussion group participants were asked to respond to a number of questions that related to the quantitative findings and to their approaches to dealing with science resources, education, teachers, and students.

Collection Development in Science

In the first discussion question, respondents were asked "How do you approach science collection development in your school media program?" All of the respondents provided answers to this question. Dominant themes in participant responses included the age of science collections, the involvement of science teachers in the collection development process, and the selection of science materials.

Six respondents mentioned the age of their science collections and their efforts to bring the collections up to date. Usually, school library media specialists had to remove outdated materials before the collections could be updated. One respondent mentioned, "I found books in the collection dating [back to] 1928 . . . many in the '50s and '60s. There were several books on how to use a slide rule." Another respondent concurred by stating, "There were science books dating back to the '50s and '60s . . . I have heavily weeded and spent a huge amount of time on the science section. I figured it was better not to have a book than to have an [out-of-date] resource."

In an effort to update the collection, most respondents attempted to engage science teachers in the collection-development process. As one respondent noted, "I work with teacher[s] on collection development. If there is something that they want me to order for use in their classrooms, I will get it for them." Another respondent tried to get science teachers to work outside classrooms and to contribute to the selection of resources for the SLMC. "I also began developing relationships with science teachers to find out what they did with books, if anything," the respondent wrote. "As it turns out science folks had little knowledge of what we had, or how they could use it. They were not media center users."

Lack of background in science may make some school library media specialists more likely to include science teachers in collection development. Respondents had varying success with the inclusion of science teachers in this process. One respondent wrote:

> Since science is not my background field, I was concerned that I would be discarding the Bible of some area of science unless I had "the experts"

> check my work. Some teachers have really helped me a lot with this. Though they do not use a lot of the books, nor necessarily encourage students to do so either, at least we are getting together to create a more respectable [Dewey call number] 500, 600 section. I have also learned a lot about what makes a good science book through this process.

This respondent's experience contrasted with the experience of other school library media specialists. Another respondent commented, "I do not ask teachers to help weed very much, because if I do, they want the withdrawals. I do not put outdated materials into classrooms." School library media specialists in the discussion group tried a variety of means to engage science teachers in the collection development process: distributing book lists, holding materials viewing sessions, asking for copies of assignments and textbooks, and attending departmental meetings. Nonetheless, one respondent wrote, "I try to work with teachers. I have had some success, but would really like to have a true collaboration. It seems to be hit or miss."

Importance of Video in the School Library Collection

The second discussion question was, "How is video used with science in your school library media program?" Because all discussion group members mentioned the importance of including video in their SLMC collections in the first discussion question, they were asked to comment specifically on the role of video in their SLMC collections and services. The predominant themes in the responses to this question were: children's learning styles, competition with classroom collections, and need to adequate equipment. "[T]eachers rely heavily on multimedia, Internet, and video," one school library media specialist offered ,while another agreed:

> Video is used a lot ... I am assuming in support of what teachers are trying to teach. ... The majority of students today are visual learners, therefore, anything visual: manipulatives, videos, pictures, posters, computer animations are very appealing (to kids) and make teachers more comfortable in presenting new concepts.

Collection development practices reflected this style of student learning. "This group does ... ask for videos and DVDs, and that is the greater part of our science collection. They also have tons of laser discs," one school library media specialist wrote. Another respondent offered, "I have spent a lot of money on videos that they [science teachers] have requested, or videos that I have brought to their attention. ...We do have a substantial video collection."

The widespread use of video seemed to be a mixed benefit to some SLMCs. Video can actually resulted in a decrease in SLMC use, as one respondent wrote. "Unfortunately," she lamented, "there are only two science instructors who use the library for science projects. The majority relies on textbooks and videos/DVD." The reliance on videos in teaching can result in hoarding, actually undermining collection practices. One school library media specialist shared the situation in her school:

> Video/DVD are important to teachers, and to an extent to the collection. However, at this school there is a history of teachers keeping the videos they want in their rooms. I take exception to that because library funds are for the benefit of all. I do not have the time nor the inclination to process a video for one person's use ... I will purchase on request, as long as it is to be housed in the library. I do a collection "round-up" every year.

Even taking into account the challenges of maintaining a video collection, most respondents considered providing videos and video equipment an important part of their service. As one respondent noted, "Equipment used to be the biggest concern, but that was solved this summer [with] the purchase of TVs and VCRs."

Influence of Professional Preparation

In the third discussion question, the participants were asked to comment on how well their prior experiences, education, and current activities prepared them to work with science teachers: "What type of professional preparation do you feel best positions you to work with science teachers and students?" A group of themes emerged from this discussion: undergraduate experiences, graduate school media coursework, professional development, and other types of learning activities.

Only a few respondents had undergraduate educations that focused on science. As one school library media specialist wrote, "In my case, my college experiences have put me in a good position to work with science teachers ... " She went on to detail summer internships at science camps and ecological research facilities. These college experiences can make school library media specialists more confident in approaching science teachers. One school library media specialist shared, "My college majors are earth science (a combo of basic ES courses, as well as biology and others) and English. So, I am fairly comfortable with the needs of our MS teachers (where most of the earth science concepts are taught)." However, these undergraduate experiences can lose their influence as a school library media specialist's career progresses. Another respondent emphasized this point 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."

The coursework for a master's degree in library science often did little to mitigate the effects of a lack of or distant undergraduate science education. "My MILS had nothing to do with K-12 science," one school library media specialist offered. Building on that idea, another respondent shared, "In my MLS degree preparation, I had a general reference course and social studies and humanities reference courses (called bibliographies)." Other school library media specialists wrote about coursework in nonfiction collection development, but with little emphasis specifically on science. One school library media specialist had a different experience and learned a lot about science in her graduate coursework. She stated, "I took the required science bib course for my MLS and trained at the National Library of Medicine while a medical librarian." However, unless an individual had originally begun a master's in library science program with the intention of becoming a medical or science librarian, there seemed to be little opportunity to become fluent in science topics.

Professional development opportunities have not always been viable routes for school library media specialists to gain science knowledge. "Lately, the majority of professional development has been in technology," a respondent noted. It is not clear whether some respondents encountered a dearth of professional development opportunities in science or if they were not interested in the science offerings. One school library media specialist wrote, "Since becoming a library media specialist, I have not attended any science professional development [programs]." Many school library media specialists, however, seemed to express interest in learning more about science through professional development, such as one who stated, "I would like to take a professional development class on using GPS in the science classroom . . . I feel I need to know more about this tool before I approach teachers."

In an effort to compensate for their lack of experience with science topics, school library media specialist s in the discussion group undertook a variety of alternatives to school-provided professional development. Some respondents sought coursework outside of school. As one school library media specialist wrote, "I've availed myself of opportunities to take Bureau of Education and Research (BER) courses in [science topics]. ... Most of the district-sponsored professional development has been focused on literacy, especially teaching reading."

For other respondents, a popular method of gaining familiarity with science topics was to attempt to participate in department meetings and on curriculum committees. "I did participate on the district committee that was selecting new science materials for the K-12 curriculum," one respondent wrote, and another added, "I have attended a science department meeting (one of two so far this year) but they didn't talk content ... " Even when school library media specialists were welcomed into the meetings, other barriers prevented the changes they suggested from taking place. As one respondent reflected:

> I tried to influence the district science committee to look at adding hand-helds to the science classrooms. ... The teachers were very interested, but the budget constraints caused them to choose having three desktop computers added to each middle school science classroom over classroom sets of hand-helds.

For the school library media specialists who attempted to join in this method of collaborative planning and outreach, these venues increased their involvement in science.

More commonly, respondents replied that they were not able to successfully join department- and building-level science discussions. A school library media specialist shared the misperception her fellow faculty members have of her desire for involvement:

> Our staff works together during professional development days to determine if we are teaching the necessary skills to be successful on the MEAP .... so some professional collaboration time has been available. However, I am usually sent to the English [department] as no one seems to see the connection [with] library and science.

One school library media specialist shared her experience being firmly excluded from district-level curriculum planning activities despite their importance to her job. She wrote:

> The biggest challenge is keeping up with curriculum changes ... just when I am "on top" of [it] ... it changes. ... When I inquired about participation on the curriculum committee (so I could anticipate changes), I was discouraged by the media director and then told no by the central office chairwoman.

Another respondent spoke about her desire to learn more about science and mathematics by taking more of an active role in classroom activities. However, the scheduling structure in her library left her with no assistance and an inability to leave the SLMC to engage in outside activities. As mentioned by other group participants, these types of barriers often result from administrators' perception of the school library media specialist's role. As this respondent stated, "My principal does not see the value of collaboration. He wants me in the library to check out books." Yet she was undaunted by the many obstacles she faced to providing services to science education and students. She also added, "I feel that, despite my lack of scientific knowledge, with my careful work we are on the way to developing a science collection which will pique the interest of middle school students."

Dynamics of the Science Classroom

In the final discussion question, participants were asked to comment on "How do you feel that the resources in the science classroom affect your ability to be involved with science?" Respondents were asked to think about how the resources in these classrooms and the instructional styles of the teachers in these rooms either contributed to or detracted from use of the SLMC's services. The themes that emerged from this discussion were classroom-bound teaching styles, use of computers, and the promise of collaborative activities.

In prior questions, some participants mentioned science teachers' hoarding of materials in their classrooms. This practice can prevent other teachers from having access to current and appropriate resources for building science curriculum. The maintenance of classroom collections actually may be symptomatic of science teaching styles that tend to be classroom-bound. Classroom collections were often described as supplementing laboratory experiments and textbooks--both of which tend to exclude the school library media specialist . As one respondent reflected:

> The materials in the science labs directly affect my ability to be involved with science. Since renovation, the labs are very state-of-art, and the library is not considered necessary. ... Lab activities do not involve me. I am never consulted nor informed. ... Textbooks are used extensively. Also, teachers have well-stocked libraries in their classrooms, which to them confirms their beliefs that the library is not needed. It is easier to do what they do with books in the classroom rather than bring classes to the library.

Textbooks seemed to be prevalent in science teaching, often to the exclusion of more constructive activities in the SLMC. As a respondent described, "Two years ago new science textbooks were purchased and these books tend to take up their classroom time. ...I'd say six out of eight science teachers are textbook-based in teaching." Another school library media specialist concurred by offering, "Each student is assigned a textbook. It seems teachers cannot operate without textbooks (especially new teachers)." In schools where classroom labs were used in conjunction with the textbook, school library media specialists in the discussion group agreed that they had difficulty penetrating the science-teaching activities. In frustration, one respondent shared, "What are they teaching them in university? Why don't preservice teachers have to take a course on using the library?"

As one respondent noted, "My observation is most [science teachers] feel secure [within] the confines of their own classroom. When teachers venture outside of this environment all kinds of things are open to criticism." Staying in the classroom does not necessarily mean that teachers did not appreciate the SLMCs services. As one respondent explained, "[T]he ... one [science teacher] is creative and does interesting projects but doesn't want to let anyone into his world. He does however ask for library materials on a cart to be in his room when doing some of these projects."

The participants had been very creative in encouraging science teachers to work outside their classrooms. The physical space of the SLMC often appeals to science teachers. One respondent described a tank of salmon that resided in the SLMC for a long-term science project; another school library media specialist described an inflatable planetarium that was set up in the SLMC for a week-long astronomy project. Another respondent emphasized the strategic importance of offering the SLMC space to science teachers: "We also housed the human torso in the media center and other 'body parts,' provided space for ... projects, cell posters, [and] probability games, etc., when it was time for student projects to be displayed."

In addition to physical space, some school library media specialists were able to lure science teachers to the library with technology. The discussion groups' SLMCs often contained the largest numbers of computers in the school; when science teachers needed to use computers for a project, they often sought the school library media specialist's help. "Basically," one school library media specialist wrote, "there is a huge competition here for who can use the computers first, fast ... we have only twenty-nine here in the LMC, so with 1,100 kids sharing them you can imagine the difficulties...." Competition for library computers was often craftily used as an opportunity to introduce science teachers to other SLMC materials, as one respondent demonstrated: "There is so much competition for use of the ... [computers] here that I have to really work the schedule to make sure everyone has an opportunity to do what they want ... and I am encouraging them to try books--they have information too!"

A recurring theme of the school library media specialists' responses to this discussion question as well as to the previous three questions was the promise of collaboration. Time and again, discussion group participants spoke of the power that collaboration with teachers had to give them a greater understanding of the curriculum, a clearer view of the supporting materials the SLMC needed to contain, and a way to demonstrate their abilities to act as instructional partners. As one school library media specialist pointed out, "I believe collaboration is my most important job and make that my number-one priority. If cataloging does not get done in a timely manner, so be it." School library media specialists in the discussion group resorted to a variety of creative methods to connect with teachers and to overcome the structural barriers to collaboration they faced. "The truth is that I do most of my collaborating at lunch time ... I drop a lot of ideas during this wonderful thirty-minute period of the day and often that gets the ball rolling," one respondent wrote. She continued, "I've found that if you can get one teacher doing something interesting and meaningful with you, the others often want to jump on board." Despite their manifold challenges, school library media specialists remained confident that the ability to collaborate would help them more effectively serve science teachers and students. One respondent contributed, "Experiences that would be beneficial would be closer collaboration with science teachers and opportunities to observe and work with teachers in the classroom."

However, school library media specialists' efforts may be in vain; as one respondent observed, "It's unfortunate that all subject areas are increasing feeling pressured by testing. It puts more pressure on them to get through everything in the text and less time for meaningful research and cross curriculum instruction."

A summary of the themes from the participant group discussions is illustrated in figure 2 . The first column contains the discussion question. The second column lists the condensed codes, or themes, discussed in this section. Overall, the themes displayed in the table depict the story told by the school library media specialist discussion group: science teachers tend to use their own or library materials within the confines of their classroom unless that space is too small. Either as a reason or as a result, some SLMCs are old and underutilized. On the whole, school library media specialists were unsure of how to address this situation because their professional training and various systemic factors made collaboration and communication with science teachers difficult.

Discussion

When integrated, the results of the quantitative and qualitative analyses are significant for school library media specialists, teachers, and administrators. These findings have implications in light of the school library media specialist roles espoused in *Information Power* (AASL and AECT 1998): learning and teaching (instructional) role, information access and delivery role, and program administrator role. Within each of these roles, school library media specialists performed activities relating to collaboration, technology, and leadership.

Question 1. How is the relationship between school library media programs and reading achievement similar to the relationship between school library media programs and science achievement?

The overriding research question of this study was to determine if school library media programs have similar relationships to science achievement as to reading achievement. The results of this study suggest that the relationship between school library media programs and science achievement had some similarities to the relationship between school library media programs and reading achievement documented in previous studies, but it also had some key differences.

This study based its quantitative methods on the 2002 MSLS (Rodney, Lance, and Hamilton-Pennell 2003). The study was a replication of other state studies that used data collected through school library media specialist-completed surveys, demographic data, and student reading scores to explore relationships between school library media programs and student achievement. The findings of these previous studies were largely similar: strong school library media programs led by credentialed school librarians had a positive relationship with student achievement in reading.

The Collection Is Important to Science Learning

In many ways, the results of this study are in line with previous studies about the relationship between school library media programs and reading achievement. While this study also concluded that staffing levels, staff credentials, and staff activities had a positive relationship to science achievement, its findings diverged from the earlier state-focused studies. Because the quantitative findings indicated the importance of videos in the SLMC to science teachers, it is possible that for science education, the presence of multimedia in the SLMC collection is more important than the way the center is staffed.

The results of the qualitative part of this study confirm that school library media specialists interact with science teachers in a variety of ways and with varying levels of perceived success. Although the bivariate analyses indicated that many school library media variables relating to staffing, usage, school library media specialist activities, the school library media collection, and technology had a significant relationship with science scores, multiple regression analyses that took into account community and district wealth factors reduced the influence of these many variables to just one: the number of videos per one hundred students.

Question 2. What are the characteristics of school librarians and school library programs that influence the relationship to science achievement?

In the learning and teaching, or instructional role, school library media specialists have the responsibility for directly instructing students as well as for instructing students as part of a teaching team. Previous studies in this area (such as van Deusen 1996; Straessle 2000; Slygh 2000) indicated that school library media specialists strongly desired to exercise this role, but often did not get the opportunity to because such systemic factors as scheduling, administrator beliefs, and teacher attitudes prevented them from taking action.

Building-Level Leadership Sets the Collaborative Tone

Although the individual correlations in the quantitative analyses indicated that the number of credentialed and other library staff members and the numbers of hours they were available for individual and group visits to the SLMC were significant, when NSLP and DPPE levels were taken into account, none of these other factors was significant.

While this correlational finding may not mean that SLMC staff has no relationship to science achievement, it may reflect the influence factors addressed by previous studies. Discussion group members mentioned the influence of principal support as well as classroom-bound instructional approaches, such as textbooks and labs, as barriers to increased collaboration with teachers. The media specialists' responses strongly implied that they were not often included in the science classroom planning process; media center resources and services may not be factored into many science programs.

Question 3. How do school library media specialists feel that yearly testing in science and other systemic pressures will affect their relationship with science educators and students?

In the information access and delivery role, the school library media specialist acquires and maintains a collection of print, nonprint, and electronic resources that support the curriculum. Researchers in prior studies (e.g., McCracken 2000; Martin 1997; Mosqueda 1999) found that school library media specialists most often exercised this role for students and teachers. School library media specialists who participated in these studies felt that the provision of the current, complete, and attractive resource collection was their overriding duty.

Science Learning Demands Shared Visual, Hands-on Resources

In this role, school library media specialists seemed to have the closest relationship with science education. The quantitative variables relating to the collection, such as number of books, number of videos, access to electronic periodical databases in the library and elsewhere, were significant. However, when these variables were examined in light of NSLP levels and DPPE, only one collection-related variable remained significant: video. The number of videos per one hundred students in a SLMC's collection accounted for a significant, but not substantial, 2 percent of the variation in science MEAP scores.

Discussion group members described their efforts to renew and revitalize very old science collections filled with books and other materials not linked to the curriculum or not suitable for students' reading levels. As a result, many school library media specialists in the discussion group mentioned that teachers had developed their own classroom collections and hoarded materials in their classrooms. The SLMC collection was not included in science teachers' instructional planning, although science teachers made frequent use of the visually mediated resources.

The discussion group members echoed the importance of video in their science collection and outreach strategies. In many instances, school library media specialists made efforts to include science teachers in the selection of new materials and the weeding of old materials, but all of the participants mentioned the importance of their video collections to science teachers. Some of the school library media specialists mentioned teachers' frequent use of video as a medium that helped students to understand science concepts. School library media specialist s ensured that the library had not only videos available to teachers but also adequate access to TVs and VCRs. In some instances, the presence of attractive video collections seemed to feed the classroom hoarding practices that undermined their collection revitalization efforts.

Question 4. What factors do school library media specialists identify as key to effective interactions with science teachers and students?

The program administration role involves effective management of the human, financial, and physical resources of the school library media program. This role also provides leadership by establishing relationships within the larger learning community. The findings of previous studies performed in this area (such as Baughman 2000; Lance, Rodney, and Hamilton-Pennell 2000a; Rodney, Lance, and Hamilton-Pennell 2003) converged on a number of themes, such as the importance of adequate credentialed staffing and principal support to facilitate collaboration with teachers and integration of SLMC services into the curriculum.

In bivariate correlations, variables relating to the presence of credentialed staff and the amount of access students had to staff were significant. Variables relating to school library media specialist activities in the school beyond teacher collaboration also were significant. However, when NSLP and DPPE were taken into account in the multiple regression analyses, no variables relating to staffing levels and activities had a significant relationship with science achievement.

School library media specialists who participated in the discussion group did not emphasize the influence of their credentials in the quality of their service. They did discuss the influence their principals have on how teachers and students perceive their roles in the schools, as well as their abilities to interact with professional development opportunities, committee work, and collaborative activities with teachers. As one school library media specialist said, "My principal does not see the value of collaboration. He wants me in the library to check out books."

The discussion group participants mentioned one aspect of the program administration role that has not been presaged by prior studies. Teachers in the discussion participants' schools utilized the physical space of the SLMC for science extension activities and group projects. School library media specialists were able to manage the library schedule to allow adequate time and space for such features as a salmon tank, a science fair, and a mobile planetarium.

Implications of the Study for Policy and Practice

The first implication of this study is that there are characteristics of school library media specialists and school library programs that relate to science achievement. The quantitative findings suggest that the one aspect of the SLMC collection--video--had the strongest relationship with science achievement; the qualitative findings suggest that school library media specialists' confidence in engaging science teachers is linked to their personal confidence and experience with science topics. But it should be noted that poverty-related factors overwhelmed all school library media variables in their relationship to science achievement.

Standardized Testing Limits Opportunities to Learn

The second implication of the study is that school library media specialists felt that curriculum demands and other systemic pressures affected their relationship with science educators and students. School library media specialists who participated in the discussion group described situations in their schools where science teachers concentrated their teaching efforts on textbooks and laboratory activities. The focus on covering the science curriculum left little opportunity for complementary lessons in the SLMC. It should be noted that the sole significant quantitative variable, number of videos per one hundred students, reflects items that are used in the classroom and not in the SLMC. The mere purchase or provision of videos is rarely a springboard for deeper collaboration.

Given that students have named multimodal learning as important to the way in which they learn science best, and that research has shown that guided, but student-centered and active, learning exposure helps students in thrive in inquiry-based environments, the findings of the second implication are somewhat confusing. On the one hand, the prevalence of science video in the school library suggests that teachers are making an effort to somewhat vary the ways in which they present science material to students. On the other hand, the focus group participants described teachers as concentrating their instructional strategies on textbooks and other static, classroom-based materials.

Professional and Topical Confidence Key to Building Collaboration

The third implication of the study is that there seem to be factors that school library media specialists identify as key to effective interactions with science teachers and students. School library media specialists who participated in the study felt that their education and background in science were important in encouraging them to initiate and further their relationships with science teachers. Although school library media specialists also reported that they could offer some valuable assistance despite their direct experience with science, many of the participants said that teachers' willingness to include the school library media program in their activities stemmed from their desire to deliver the science curriculum in a certain manner as well as administrators' attitudes toward collaborative teaching.

This implication is especially interesting given the established research that both points to the type of learning that can happen in the media center and to the fact that teachers' preferences lie elsewhere. Given this dichotomy of practice, successful collaborative relationships are likely reserved for school library media specialists and science teachers with keen appreciation for each other's skills, professional philosophy, and resource or content base. To be sustainable and workable, collaboration between school library media specialists and science teachers will need to start from mutual understandings of how the two programs can complement each other.

The fourth implication of this study is that for science students, SLMCs staffed by persons other than credentialed school library media specialists can negatively relate to achievement. Nine out of the eleven variables with negative correlations recorded numbers of staff members with varying levels of education other than the master's degree in library science and teaching certification with school library media endorsement requisite of school library media specialists. Although not significant, these correlations suggest that a closer look at the potentially deleterious effect of uncredentialed staff on student achievement should be examined.

Conversations about domain strengths, resource collections, and learning strategies tend to be enabled by the type of information credentialed school library media specialists gain in their preservice education. Leadership is very important in expressing the professional confidence and depth of program knowledge to persuade classroom-bound science educators that SLMC activities connect with their curriculum and that collaboration will result in better student experiences and improved interaction with science content.

Information Access and Delivery Is a Starting Point

The results of this study suggest that the roles described in *Information Power* (AASL and AECT 1998) still accurately describe contemporary school library media specialist activities and responsibilities. Current research cited in the introduction to this paper and the responses of school library media specialists who participated in the discussion group describe job responsibilities in terms of the learning and teaching role, the information access and delivery role, and the program administration role, but they emphasize that the roles are not performed equally, and some not at all, in relation to science education.

The role of the school library media specialist in information access and delivery is important for science education. In addition to the significant relationship of the "videos per one hundred students" variable to science achievement, school library media specialists who participated in the study focused on building attractive collections that would facilitate cooperative relationships with teachers and students. The study's findings create a possible route for school library media specialists who wish to forge closer relationships with science educators. The acquisition and use of video (and perhaps of other nonprint forms) must be a key part of the collection development and collaboration strategies. School library media specialists may wish to focus their in-service and professional growth opportunities on gaining familiarity with new video technologies, such as streaming video-on-demand services.

Suggestions for Further Research

This study, like the previous statewide studies in the United States, acknowledged that poverty-related variables accounted for an overwhelming amount of variance in middle school student achievement in reading and science. Although this study also found that school library media program variables also had positive correlations with student achievement in science, these correlations were not significant enough to explain a substantial amount of the remaining nonpoverty variance in student test scores. A fertile area for exploration might be to investigate in depth the variables that do account for a substantial amount of the remaining variance and how these variables relate to the school media program.

Another potential area for investigation is extension and refinement of the methods used in the MSLS and its counterparts. The data set is based on information about schools whose staff members returned surveys; however, the survey yielded a moderate (27 percent) return rate (Creswell 2005). These approaches could include revision or alteration of the school library survey instrument, adjustment of methods used to encourage return of surveys, and re-examination of the data analysis techniques. Reworded questions, additional questions, enhanced survey completion and return incentives, and different statistical analyses might uncover new and additional relationships between school library media programs and student achievement.

Correlation Puts Causation in Reach

Correlational studies do not offer readers causal relationships; researchers' interpretations of the results of these studies are often subjective and not absolute. And, when these analyses are applied to survey results do not reflect a random sample and that may reflect respondents' personal motivation or time to complete the survey, peculiarities of the instrument, or any number of other factors that can influence the survey returns, greater caution must be used in drawing definitive conclusions or mandates.

The Colorado-style studies report significant, positive correlations to advocate for the support for school libraries, and perhaps that commitment to advocacy underscores the imperative to take the analyses further. Correlation should be the staring point, not the focus of advocacy, since it is so often misinterpreted or overclaimed. As Ross (2001, 142) points out, "Ostensibly, the difference between correlation and causation is easily understood for scholars, but what about laypeople, those whom we study and whose behavior we seek to alter? Apparently, laypersons are readily sold on cause and effect relationships, and that is the problem."

In order to support school libraries authentically, future research should lend depth and sophistication to the relationships suggested by correlation. Additional work must examine why and how specific types of interactions between school library media specialists and teachers occur in an educational ecosystem. By exploring such dimensions as preservice education, leadership, and student attitudes using techniques beyond correlational analyses and in contexts larger than that of a media center, true causal relationships can be uncovered and realistic expectations can be set for how the media center can thrive.

Likewise, an additional direction for research would be to examine the features present in the school libraries, school librarians, and science teachers of selected high- and low-achieving districts in science. A comparison of these qualities would also be a solid starting point for establishing any causal relationships between school library media programs and science learning.

Regardless of the wealth of a community or district, SLMCs with large collections of videos also have students who are doing well in science. However, the growing popularity of streaming video services that feed directly into the classroom and circumvent the school library media specialist may diminish the current positive relationship of SLMC video to science achievement.

The clear message from this study is that the ability of school library media specialists to provide science educators with current materials in a variety of visually mediated formats in an attractive, accessible space is an important part of service to science educators and students. By leveraging the provision of multimedia and physical resources into collaborative opportunities, school library media specialists can further the roles described in *Information Power* (AASL and AECT 1998) and support student achievement in science.

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Epilogue

Fifteen years and two versions of *Information Power* later, it would appear that school library media specialists are still literally and figuratively managing the AV carts. Now, school libraries may contain DVDs and streaming video servers instead of VHS cassettes, but the end result is the same. That is, the school library's most influential function for science learning, of the aspects studied, is the provision of materials science teachers do not already have in their classroom collections. Deep collaborations with science teachers that make use of the expertise and resources of the SLMC are not consistently occurring, and their infrequency may the squeaky wheel (of the AV cart) that needs our intellectual and professional grease.

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Table 1. Summary of Community, District, and Building Variables for School in the Study Sample

Variable	N	M	SD
Community			
Average salary	192	$49,710	6708.00
High school graduation rate	194	84%	7.07
District			
Percent of students eligible for NSLP	188	30%	.23
DPPE	196	$3536	585.00
Building			
School enrollment	196	592	248.00
Percent of minority student enrollment	196	19%	.27
Pupil-teacher Ratio	196	5:1	.81

Table 2. Descriptive Summary of Means for Selected SLMP Variables in the Present Study

		M		SD	
Variable	N	No.		Hours	
Paid staff		**M**	SD	M	SD
Credentialed SLMS	196	.74	.46	25	18.44
Total staff	196	1.88	.81	58	23.87

Staff activities (hours per week)					
Teaching students cooperatively	196	4.90		5.36	
Providing in-service training	196	1.58		1.96	
Identifying materials for teachers	196	3.80		3.17	
Performing collection development	196	3.57		3.81	
SLMC usage (per week)					
Total visits by classes or groups	194	21.00		13.93	
Total visits by individuals	196	287.00		242.14	
		SLMC		Elsewhere	
Computers		M	SD	M	SD
Total computers	196	30	40.01	72	72.33
Access to the Internet	196	26	38.44	78	70.72
Access to MeL databases	194	24	38.21	57	69.60
Access to SLMC databases	192	24	51.40	58	78.91
Access to SLMC catalog	190	20	31.00	56	76.23
SLMC collection					
Total volumes	193	9878		4633.37	
Video materials	191	231		279.05	
Periodical subscriptions	194	32		22.46	
Annual operating expenditures					
Total expenditures	192	8143.15		6001.69	

Table 3. SLMP Variables and MEAP Reading and Science Scores: Positive Correlation

	Reading			Science
Variable	n1	r1	n2	r2
Total number of paid staff	200	.324	192	.325

Credentialed SLMS hours per week	200	.353	192	.289
Total paid staff hours per week	200	.333	192	.276
Access to library databases on computers in school	162	.268	156	.275
Video materials (cassettes and disks)	190	.144	182	.256
Total library computers	198	.252	190	.242
Total visits to the library by classes or groups	193	.236	185	.242
Hours available for flexible scheduling	197	.368	189	.238
Number of credentialed SLMS	200	.344	192	.237
Access to state-funded databases on library computers	193	.271	185	.233
Access to state-funded databases on computers in school	157	.262	151	.232
Access to the Internet on library computers	198	.230	190	.225
Access to library databases on library computers	191	.215	183	.222
Books of all types	192	.321	184	.219
Student access to the library catalog on library computers	189	.270	181	.216
Access to the Internet on computers in school	167	.278	161	.211

Note: Reported values of r1 and r2 are significant at the .01 level.

Table 4. SLMP Variables and MEAP Reading and Science Scores: Negative Correlations

	Reading		Science	
Variable	n1	r1	n2	r2
Master’s degree in library science staff hours per week	197	-.068	189	-.087
High school diploma only staff hours per week	199	.011	191	-.076
Number of master’s degree in library science staff	197	-.051	189	-.071
Master’s degree in library science and other teacher	198	-.049	190	-.052

certification hours per week				
Number of master's degree in library science and other teacher certification	198	-.047	190	-.051
In library use of materials per typical week	187	-.091	181	-.034
Number of high school diploma staff	199	.026	191	-.016
B.A., but no teacher certification staff hours per week	197	-.115	189	-.015
Hours spent weekly meeting with building or district administrators	199	-.052	191	-.008
Hours open during typical summer week	198	-.036	190	.000

Figure 1 . Clusters and Variables Used in Multiple Regression Analyses

Cluster	Variable
Service hours	Hours available for flexible scheduling
Paid staff	Credentialed SLMS
	Total staff
Paid staff hours	Credentialed SLMS hours
	Total staff hours
Staff activities (in hours)	Teaching students cooperatively
	Providing in-service training
	All other library activities plus extra duties
	Identifying materials for teachers
School library media center usage	Total visits by classes or groups
	Total visits by individuals
Computers in school library media center	Total computers
	Access to MeL databases
	Access to the Internet

	Access to SLMC databases
	Student access to SLMC catalog
Computers in school	Access to SLMC databases
	Access to MeL databases
	Student access to SLMC catalog
	Access to the Internet
	Total computers
Collection	Video materials
	Books of all types
	Encyclopedias and reference titles on disk
Expenditures	Total expenditures

Figure 2. Summary of Discussion Questions and Themes in Qualitative Data

Question	Themes
1. How do you approach science collection development in your school media program?	o Science collections tend to be old. o Science teachers are erratically involved in the collection development process. o The selection of science materials is challenging. o Video is an important part of science collection development.
2. How is video used with science in your school media program?	o Student learning styles amendable to video. o Competition with classroom collections leads to underuse or hoarding. o School library media centers must have enough equipment.

3. What type of professional preparation do you feel best positions you to work with science teachers and students?	o Undergraduate experiences influence service areas. o Graduate coursework did not prepare SLMS for science. o Professional development opportunities scarce. o Other learning activities have to be sought.
4. How do you feel that the resources in the science classroom affect your ability to be involved with science?	o Classroom-bound teaching styles hinder school library media center use. o School library media center computers and space bring teachers. o More collaborative activities would improve relationship.

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