School Media Programs and Middle Grades Science Achievement: Results of a Study Performed in Michigan, USA

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This paper describes a research study, completed in late 2004, in which the researcher examined the relationship between school media programs and science achievement in grade 8 students in Michigan schools. This paper reports the results of a mixed method sequential explanatory study undertaken to uncover the connection between school 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.

Background

Now is a critical time in the reform of science teaching of K-12 students in the United States, as the federal *No Child Left Behind* (NCLB) education legislation is being deployed with its emphasis on teacher quality, administrative accountability, evidence-based practices, and student achievement measured through standardized tests. The impact of these mandated tests, to be administered annually with high-stakes outcomes for schools, is 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, requirements of NCLB will result in significant change in the nation's schools as the act is implemented in full. When students continue to lag behind in science achievement, undoubtedly there will be pressure to improve achievement in this area.

Researchers of Library Research Service's Colorado Study initially established a link between strong school media programs and reading achievement in 1993 and in 2000 (Lance, Rodney, & Hamilton-Pennell, 2000b; Lance, Welborn, & Hamilton-Pennell, 1993). The Michigan School Library Study (MSLS) conducted by the same researchers, replicated and confirmed earlier conclusions (Rodney, Lance, & 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 media programs on science achievement is undocumented.

In many ways, science classrooms and school media centers are parallel universes struggling with their own reform issues and with documenting their own positive impacts. As the trend toward data-driven decisions grows in the school setting, it is increasingly important that every component of the learning environment to have demonstrable effect and to be mutually reinforcing. Yet, science reformers seem to not

recognize the potential for school media specialists to support their efforts (National Center for Education Statistics [NCES], 2002) nor do school media practitioners and researchers seem to be building relationships with science educators (Abilock, 2003).

The lack of communication between school library media specialists and science educator may be a bidirectional problem. While science educators rely on classroom activities for the conveyance of science topics, school library media specialists lack support to engage science educators (Mardis, 2005a). School media practitioner literature rarely addresses science-related topics. While leading publications do contain a number of articles emphasizing the importance of collaboration, less than 5% of articles published between 1998 and 2003 were devoted to any aspect of working with science teachers or students (Mardis, 2005 April). 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 media specialists and science educators (Mardis, 2005a). As this paper demonstrates, barriers to collaboration between science teachers and school library media specialists are possibly as much human issues as structural impediments.

Statement of the Problem

If strong school media centers positively impact middle school student reading achievement, can the same be said for middle school science achievement? The 2002 Michigan School Library Study showed that school media specialists' supports, attitudes, and motivations play essential roles in promoting student reading achievement (Rodney et al., 2003); many of the questions that led to this conclusion may be asked about the effect of school media programs on science achievement. Research questions addressed in this study include:

- 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 librarians and school library programs that influence the relationship to science achievement?
- In what ways do SLMSs 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 intrinsic and extrinsic relationships between science education and school library media programs. The research reported here embodied a mixed-methods approach using both quantitative and qualitative techniques.

First, quantitative data composed of the MSLS data set and 2002 eighth-grade MEAP state-administered and mandated science test scores were collected and analyzed. Bivariate correlations were used to identify variables from the MSLS survey (as described below) that had significant correlations with eighth-grade MEAP science

scores. The significant variables were clustered according to their MSLS survey category and then used in multiple regression analyses with the predominant predictive factors of science achievement, percent of school students eligible for the United States' National School Lunch Program (NSLP), and district per-pupil expenditure (DPPE). The last two variables are indicators of poverty in the United States.

Next, qualitative data were collected in an effort to explain the findings of the correlational analyses. An email discussion group composed of 11 school library media specialists from across Michigan reviewed, reflected, and responded to four questions about their interactions with science learning and teaching resources, science teachers, and science students.

Summary of Results

The results of the two data-gathering approaches are presented in two separate sections, Quantitative Results and Qualitative Results.

Quantitative Results

Variables in nine of the MSLS survey clusters had significant Pearson's product moment correlations with eighth-grade MEAP science scores. In the Service Hours cluster (n=5 variables), one variable, "hours available for flexible scheduling," was significant. In the Staff cluster (n=11 variables), "credentialed SLMS" and "total staff" variables were significant. In the Staff Hours cluster (n=11 variables), the "credentialed SLMS hours" and "total staff hours" variables were significant. In the Activity Hours cluster (n=13 variables), the "teaching students cooperatively," "providing in-service training," "all other activities plus extra duties," and "identifying materials for teachers" variables each had significant relationships with MEAP science scores.

In the SLMC Usage cluster (n=8 variables), the "total visits by individuals" and "total visits by classes or groups" variables were significant. In both the SLMC Computers cluster (n=5 variables) and Computers Elsewhere cluster (n=5 variables), the "total computers," "access to MeL databases," "access to the Internet," "access to school library databases," and "student access to school library catalog" variable were all significant. In the Collection cluster, the "number of videos," "books of all types," and "encyclopedias and reference titles on disk" variables were significant. Finally, in the Expenditures cluster, the only variable, "total expenditures" was significant.

When compared individually, 25 of 74 variables (34%) that reflected many different facets—staffing, usage, technology, print and non-print resources, and funding of the school library media program—appeared to have a significant positive relationship with middle school science achievement. However, these correlations tended to be very low.

It should be noted that 11 of 74 variables (15%) had negative correlations with MEAP scores. In the Staffing cluster, five variables that described the presence of library staff other than credentialed school librarians had negative correlations; in the Hours cluster, four variables that described hours by library staff other than credentialed school librarians had negative correlations. In the Activities cluster, the "meeting with

principal and/or other building or district administrators" variable had a negative correlation as did the In library use of materials variable in the Usage cluster.

In order to investigate how much these significant correlations contributed to the overall variance in eighth grade science scores, the major predictors of science achievement were identified. NSLP and DPPE together seemed to account for approximately 60% of the variance in science scores; other community and school variables like minority enrollment, educational attainment of parents, and teacher pupil ratio accounted for an insignificant amount of the variance.

In multiple regression models, none of the clusters of significant variables accounted for a significant amount of the variance in science scores beyond the community and school predictors. When partial correlations for each variable in the clusters were inspected, one variable—videos per 100 students—showed an individual significant correlation with eighth grade science scores. This variable alone accounted for 2% of the remaining approximately 60% of science achievement.

Qualitative Results

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

The first question applied to the topic of collection development. Many of the media specialists in the group commented that they had collections with dated or insufficient science materials. To remedy this deficiency, they employed a number of strategies, including the help of teachers, to weed their collections of out-of-date materials and improve with relevant resources. Some respondents noted that assistance from science teachers was a way of creating closer relationships with them.

Since many respondents mentioned collecting video resources, the second discussion question focused on use of these resources in the science collection. The media specialist respondents agreed that video was an important part of their science collection and was heavily used by science teachers. In some instances and to the frustration of the media specialists, science teachers kept the media center's videos in their classroom and did not share them with other teachers. Despite this concern, videos were an important part of the science collection strategy in the media center.

In the third question, the researcher asked respondents to comment on their professional and continuing education. Most respondents lacked a background in science and felt that this lack of education affected the way they approached science collection development and service. Few discussion group members found professional development to be an opportunity to improve their knowledge of science topics. Attempts to serve on curriculum committees and get involved with science planning processes were occasionally successful; overall, respondents felt that collaboration with teachers was an effective but unavailable means of gaining the information about science they lacked.

The final question was about media specialists' perception of science teaching and the science classroom. In most instances, media specialists responded to the question by detailing various classroom-bound teaching approaches like use of textbooks

and hands-on laboratory experiences. Science teachers did seem to be willing to leave their classrooms to use the computers in the LMC; often these visits were the media specialists' opportunity to work with science teachers and science students. The responses to this question again underlined the respondents' confidence that collaborative teaching would benefit both teachers and students. Many media specialists specifically cited increasing collaboration as a professional goal despite the barriers to its occurrence.

Discussion

When integrated, the results of the quantitative and qualitative analyses are significant for school library media specialists, teachers, and administrators. These findings can be classified according to the media specialist roles espoused in *Information Power* (American Association of School Librarians [AASL] & Association for Educational Communications and Technology [AECT], 1998): learning and teaching (instructional) role; information access and delivery role, and program administrator role. Within each of these roles, media specialists perform 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 reading achievement and science achievement. The results of this study suggested 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 that it also had some key differences.

This study based its quantitative methods on the 2002 Michigan School Library Study. The study was a replication of other state studies that used data collected via 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 media programs led by credentialed school librarians had a positive relationship with student achievement in reading.

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

The mixed method approach used in this study gave insight into the meaning of the relationships of the variables to science education. The previous state studies relied on survey data; many prior studies relied on either survey data or interviews. The study

described here used both approaches to depict a unified picture of the relationship between school media programs and science achievement.

The results of this study do suggest that 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, SLMS activities, the SLMC 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 100 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, 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 (Slygh, 2000; Straessle, 2000; van Deusen, 1996) indicated that media specialists strongly desired to exercise this role, but often did not get the opportunity to because systemic factors like scheduling, administrator beliefs, and teacher attitudes prevented them from taking action.

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 LMC were significant, when NSLP and DPPE levels are taken into account, none of these other factors is significant.

While this correlational finding may not mean that media center 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 like 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 media specialist acquires and maintains a collection of print, nonprint, and electronic resources that support the curriculum. Researchers in prior studies (Martin, 1997; McCracken, 2000; Mosqueda, 1999) found that media specialists most often exercised this role for students and teachers. Media specialists who participated in these studies felt that the provision of the current, complete, and attractive resource collection was their overriding duty.

In this role, 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 100 students in a media center's collection accounted for 2% 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 media specialists in the discussion group mentioned that teachers had developed their own classroom collections and hoarded materials in their rooms. The media center collection was not included in their instructional planning.

The discussion group members echoed the importance of video in their science collection and outreach strategies. In many instances, 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 discussants mentioned teachers' frequent use of video as a medium that helped students to understand science concepts. Media specialists 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 library media program. This role also provides leadership within the larger learning community. Adequate staffing, budget, and administrative support are key to the success of this role. The findings of previous studies performed in this area (Baughman, 2000; Lance, Rodney, & Hamilton-Pennell, 2000a; Rodney et al., 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 media center 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 media specialist activities in the school beyond teacher collaboration were also 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.

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 over how teachers and students perceive their roles in the schools as well as their abilities to interact with in-service opportunities, committee work, and collaborative activities with teachers. As one media specialist discussant 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 media center for science extension activities and group projects. The 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 librarians and school library programs that relate to science achievement. The quantitative findings suggest that the SLMC collection has the strongest relationship with science achievement; the qualitative findings suggest that media specialists' confidence in engaging science teachers beyond collection development is linked to their personal confidence with science topics. But it should be noted that poverty-related factors overwhelmed all school library media variables in their relationship to science achievement.

The second implication of the study is that SLMSs do feel that curriculum demands and other systemic pressures affect their relationship with science educators and students. The media specialists who participated in the discussion group described situations in their schools where science teachers concentrated their teaching efforts on textbook and laboratory activities. The focus on covering the science curriculum left little opportunity for complementary lessons in the media center. It should be noted that the sole significant quantitative variable, number of videos per 100 students, is an item that is used in the classroom and not in the media center.

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. 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. Though media specialists also reported that they could offer some valuable assistance despite their 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.

The fourth implication of this study is that for middle school science students, school library media programs staffed by persons other than credentialed school library media specialists can somewhat negatively relate to achievement. Nine out of the 11 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.

The results of this study suggest that the roles described in *Information Power* (AASL & AECT, 1998) still accurately describe contemporary media specialist activities and responsibilities. Current research cited in the introduction to this paper and the responses of media specialists who participated in the discussion group perceive and

express their job responsibilities in terms of the learning and teaching role, the information access and delivery role, and the program administration role.

The role of the media specialist in information access and delivery is important for science education. In addition to the significant relationship of the videos per 100 students variable to science achievement, the media specialists who participated in the study focused on building attractive collections that would facilitate cooperative relationships with teachers and students.

The lack of ambiguity in the study's findings creates a clear mandate for media specialists who wish to forge closer relationships with science educators. The acquisition and use of video (and perhaps of other non-print forms) must be a key part of the collection development and collaboration strategies. Media specialists may wish to focus their in-service and professional growth opportunities on gaining familiarity with new video technologies like streaming video-on-demand services.

Suggestions for Further Research

This study, like the previous state-wide studies in the United States, acknowledged that poverty-related variables accounted for an overwhelming amount of variance in student achievement. Although this study also found that school library media program variables had positive correlations with student achievement, these correlations were not significant enough to explain a substantial amount of the remaining non-poverty 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 methodologies used in the Michigan School Library Study and its counterparts. The data set is based on information about schools whose staff members returned surveys; however, the survey yielded a moderate (27%) 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 reexamination 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 media programs and student achievement.

Regardless of the wealth of a community or district, school library media centers 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 and science achievement. Definite areas for investigation are strategies for school library media specialists to become more knowledgeable about all types of video resources and delivery systems as well as the barriers and helpful scaffolds to the use of non-print resources.

The clear message from this study is that the ability of SLMS to provide science educators with current materials in a variety of formats in an attractive accessible space is an important part of service to science educators and students. By leveraging the provision of these resources into collaborative opportunities, media specialists feel that

they can achieve the roles described in *Information Power* (AASL & AECT, 1998) and support student achievement.

Glossary

Collaboration: An interdependent relationship between the school library media specialist and the classroom teacher involving progressively complex levels of instructional assistance, from gathering materials to designing and executing a unit of study (van Deusen & Tallman, 1994).

Collaborative Planning: In preparation for a class visit to the library media center, the library media specialist and the teacher(s) involved plan the students' assignments, assign responsibility for teaching the relevant skills, determine student activities and the content of the final product, and assess the process and results (American Library Association [ALA], 1999).

Collection Development: The process of building a library media center collection of resources in all formats including, but not limited to, book, electronic database, CD-ROM, and video to support all areas of the curriculum, individual research, and a broad knowledge of world literature. In developing a collection, the library media specialist must take into consideration student and parent needs as well as the needs of the various professionals in the school community (ALA, 1999).

District Per Pupil Expenditure (DPPE): The DPPE reflects the amount of money per student that a public school district spends on district-wide activities such as instruction, transportation, food service, operations, and maintenance. Per-pupil expenditures are computed by dividing a school district's operating costs by the average pupil membership. Operating costs are paid from funds appropriated by the local school districts from tax revenues, state aid, federal impact aid, and other revenues.

Flexible Scheduling – A scheduling technique in which school library media specialists and teachers arrange for classes to visit school library media center on an as-needed basis instead of during set time each week.

Inquiry: The process of formulating appropriate research questions, organizing the search for data, analyzing and evaluating the data found, and communicating the results in a coherent presentation (ALA, 1999).

Michigan Evaluation of Academic Progress (MEAP) science test: The MEAP science test is used to assess student performance on five dimensions of scientific literacy: using life science, using physical science, using earth science, constructing scientific knowledge, and reflecting on scientific knowledge. On these tests, students answer multiple-choice questions and questions that require a written response. For eighth-grade science scores on the MEAP, The Michigan Department of Treasury provided scores aggregated to the public school building level based on the percentage of students who attained one of the three designations: Proficient, Novice, and Not Yet Novice.

Michigan Electronic Library (MeL) databases: The commercial databases that are available free of charge to Michigan residents through all types of Michigan libraries. These World Wide Web resources are purchased by the state Library of Michigan.

Michigan School Library Study (MSLS):

Middle School: For the purposes of this study, any public school building that serves any combination of grades five through nine that includes grades seven and eight.

National School Lunch Program (NSLP): The NSLP allows eligible students to receive school lunch at no cost or at a reduced cost. Eligibility is determined by United States federal guidelines through a review of a family's financial resources. The percentage of the student body eligible to receive school lunch assistance was then used as a school-specific poverty variable.

School Library Media Center (SLMC) or Library Media Center (LMC): Areas of a school under the aegis of a school library media specialist (Burt, 1980). These areas may include study areas, resource collections, and computer labs. They may also be called the "school library" or the "media center."

School Library Media Program (SLMP): All the functions, resources, and responsibilities of the school library media center (ALA, 1999), as well as the portion of the school curriculum that is administered solely or collaboratively by the school library media specialist (Saunders & Polette,

1975). While program activities may occur in the school library media center, they may also occur in the classroom, in the computer lab, or in other instructional environments.

School Library Media Specialist (SLMS) or Library Media Specialist (LMS): A professional staff person who holds a degree with a specialty in school library media and is licensed by the appropriate state agency (ALA, 1999). This individual may also be referred to as "media specialist," "school librarian," or "teacher-librarian."

Science Education: The curriculum administered through the science department of a school. Science education topics include life sciences, earth sciences, physical sciences, and engineering.

Selection Policy: A comprehensive district policy that provides the philosophy and general guidelines for the selection of all resources. The policy is the basis for collection development (ALA, 1999).

Weeding: The process of culling resources from the library media program collection that are no longer relevant to the interests and learning needs of the school's students, teachers, staff, and community (ALA, 1999).

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