

The Impact of School Library Media Centers on Academic Achievement

SLMQ Volume 22, Number 3, Spring 1994

[Keith Curry Lance](#), Director, Library Research Service, Colorado

Advocates of school library media centers have long been convinced of the relationship between strong library media programs and academic achievement. The need for evidence of that relationship was demonstrated by the unprecedented publicity surrounding 1987–88 reports of a proprietary study correlating higher levels of library media expenditures with higher scores on the National Merit Scholarship Test.(1) The inability of library media advocates to obtain satisfactory documentation of these findings was a major impetus for what has become known as “the Colorado study.”

During the past thirty years, fewer than forty studies have focused on the impact of library media centers on academic achievement. In addition to the limited quantity of research in this field, the studies themselves have been limited in scope. Generally, a small number of subjects in a particular geographical area were examined. Often, studies focused on one city or, at most, one state. The majority were conducted between 1959 and 1979. For the most part, this body of research supports only establishing library media centers and library media specialist positions, not strengthening them to enhance student achievement.

This study was designed both to update the existing research and to develop new insights into the relationship of library media centers and their programs to student achievement. The study applied a variety of statistical techniques to existing data on Colorado library media centers and their school and community contexts in order to develop and test a model describing this relationship. By isolating several components of library media services that are especially important predictors of student achievement, the study begins to provide the documentation of effectiveness that library media advocates have sought. A complete presentation of the study methodology and findings as well as a comprehensive annotated bibliography and timeline of the background literature can be found in the book on which this article is based.(2)

Methodology

This section explains the nature of the study sample, the kinds and amounts of data collected, and the statistical techniques applied to these data.

Ideally, schools included in a sample for a study like this would be selected on a random, stratified, or quota basis. None of these sampling designs was possible, however, because two powerful selection criteria were at play: schools included in the sample (1) had to have library media centers that had responded to the 1989 survey of school library media centers in Colorado and (2) had to use the Iowa Tests of Basic Skills (ITBS) or Tests of Achievement and Proficiency (TAP) as measures of student achievement. These data were available for 221 of the

1,331 public elementary and secondary schools in Colorado during the 1988–89 school year, and these 221 schools constituted the study sample.

The need to employ a nonrandom sample raised serious questions about the generalizability of the study’s findings. Of particular concern was the representation in the sample of different school levels, enrollment ranges, and district settings. In all three cases, comparisons of the distribution of sample schools with the distribution of all schools in Colorado and the United States demonstrated negligible variations between the sample for this study and the state and national universes of public elementary and secondary schools. Table 1 presents the sample, Colorado, and U.S. distributions of schools by level and suggests that the study sample was, in essence, representative.

Table 1. Sample, Colorado, and U.S. Schools by Level

Schools by Level	Sample		Colorado		U.S.	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
Elementary	134	61	808	61	51,339	62
Middle	24	11	129	10	7,957	10
Junior High	15	7	99	7	4,687	6
Senior High	47	21	247	19	11,350	14
Other	1	0	48	4	7,832	9
Total	221	100	1,331	100	83,165	100

Note: Rounding has resulted in some percentages exceeding 100%.

The study did not collect new information but relied entirely upon existing data about library media centers and their school and community contexts. In order to provide a thorough and comprehensive basis for the study’s multifaceted statistical analyses, a wide range of data for each of the study’s independent variables was drawn from a variety of sources.

Because 1990 U.S. Census data were unavailable at the time of the study, data on the following variables were drawn from the 1980 Census for each Colorado district that had a school in the sample:

- urban and rural percentages of the district population,
- percentages of district residents in selected racial/ethnic groups,
- percentages of district residents age 25 and older who were high school and college graduates,
- average family size,
- median family income, and

- percentage of district families living below the poverty level.

Due to the age of these data and their availability only at the district level, data on several other variables were drawn from the 1989 building-level files of the Colorado Department of Education (CDE). These items were:

- percentages of students in selected racial/ethnic groups and
- percentage of students in the Nation School Lunch Program (a potential proxy for median family income and/or percentage of families living below the poverty level).

Additional 1989 building-level data we drawn from CDE files to describe important differences among Colorado school These fell into two major categories, teacher variables and fiscal variables. The teacher variables were:

- pupil-teacher ratio,
- percentage of teachers with master degrees,
- average years of experience for teachers, and
- average salary for teachers.

The fiscal variables included:

- total district expenditures per pupil and
- percentages of expenditures spent on instruction, supplies; and materials (a subcategory of instruction), support services, and community services.

Almost half of Colorado's public schools had responded to the 1988–89 survey of school library media centers. Data for the following variables related specifically to library media centers were drawn from those schools' survey responses:

- hours open in a typical week,
- hours each week staffed by state-endorsed library media specialists,
- total staff hours in a typical week,
- hours each week spent by library media staff identifying materials to support curriculum developed by teachers and collaborating with teachers on curriculum development,
- holdings by format (book volumes, periodical subscriptions, videos, software packages, and audiovisual materials)
- numbers of microcomputers and instances of their instructional use in a typical week,
- print and nonprint circulation in a typical week,
- materials borrowed or rented from outside sources in a typical week, and
- information skills instruction contacts in a typical week.

The purpose of the study was to identify the relationships of all these independent variables to a single dependent variable: students' academic achievement. This achievement was represented by composite student scores on selected components of the Iowa Tests of Basic Skills and the Tests of Achievement and Proficiency.

For elementary and middle grades, ITBS scores on reading, writing, and work-study skills were used. For secondary grades TAP scores on reading, written expression, and using sources of information were used. These test scores were obtained for grades one, two, four, five, seven, and ten. Grades three and six were excluded because large districts in the sample were reorganizing schools in such a way as to group grades three and six with other different grades. Tenth grade was the only secondary grade for which sufficient numbers of schools had reported test scores.

Three statistical techniques were used in sequence to analyze these data. First, correlation analysis was employed to identify independent variables that were redundant (i.e., superfluous) and could therefore be eliminated from further consideration as predictors of student achievement. Next, factor analysis was employed to identify related elements within the remaining variables that would allow them to be combined into single entities, thus further reducing and refining the number of potential predictors. Finally, path analysis conducted through multiple regression techniques was employed to measure the direct and indirect effects of each potential predictor while controlling for other variables under consideration. Each successive phase of this “peeling the onion” approach yielded information about the relationship of specific variables to student achievement.

Findings

Correlation analyses were designed to identify redundant variables within the community, school, and library media center data. Analysis of community variables identified the following relationships:

- Rural and urbanized populations within school districts are almost mutually exclusive. In addition, there is little variation between those districts that are 100 percent rural and those 100 percent urbanized.
- Where more adults have graduated from high school, family incomes are higher.
- Where more adults have graduated from high school, more adults have graduated from college.
- Where more adults have graduated college, family incomes are higher.
- Where family incomes are lower, families live in poverty.
- Where fewer adults are high school graduates, more families live in poverty.

On the basis of these findings, the following community variables were discarded as potential predictors of student achievement:

- urbanized and rural percentages of population,
- college graduation and median family income, and
- percentage of families living below the poverty level.

Analysis of school variables identified these relationships:

- Schools with more teachers with master’s degrees tend to pay higher salaries.

- Schools that spend more on instruction in general almost always spend more on supplies and materials, support services, and community services.

On the basis of these findings, the following actions were taken:

- Teacher-related variables were referred to factor analysis to determine whether they could be combined into a single variable.
- Proportions of total expenditures per pupil spent on instruction, supplies and materials, support services, and community services were discarded as redundant.

While analysis of library media center variables revealed no redundancies, it identified the following noteworthy relationships:

- Library media centers with larger book collections tend also to have more periodical subscriptions.
- Library media centers that have more to spend on materials tend to have more to spend on equipment.
- Library media centers that have more endorsed staff tend to have staff who spend more time identifying materials for instructional units developed by teachers and more time collaborating with teachers in developing such units.
- Numbers of books, periodical subscriptions, software packages, and videos in library media center collections tend to rise and fall together.
- Use of library media center materials, particularly audiovisual materials, appears likely to increase as teachers begin to involve library media center staff in their instructional planning.
- The well-known impact of periodical subscription prices on library media center materials expenditures is evident.

On the basis of these findings, the following actions were taken:

- A collection size factor based on numbers of books and periodical subscriptions was attempted.
- Separate dollar figures on library media center materials and equipment spending were added together to form one variable.
- Additional combinations of library media center variables were sought solely to reduce their overall number.

In terms of the dependent variable, student achievement, analysis revealed that, in every grade, students who scored better on reading tests were extremely likely to test better on information-seeking skills and their use of language. For this reason, reading scores alone were used to represent academic achievement in this study.

After eliminating redundant variables, the second step in refining the database of potential predictors was to submit related sets of variables to factor analysis. This technique generated several scores that were used to represent groups of related variables.

Community variables submitted to factor analysis were percentage of minority students, percentage of free lunch students, percentage of adults graduated from high school, and average family size. The first three variables were combined into an “at-risk” factor. Average family size was dropped from further consideration when it was realized that it was a poor way to operationalize a student’s access to parental support, such as homework assistance. (If average family size is three, the typical family might be composed of two parents and one child, in which case the student is likely to be in a relatively advantageous position. Alternatively, the three might be a single parent with two children, in which case the students are likely to be in a relatively disadvantaged position.)

School variables submitted to factor analysis were total expenditures per pupil, teacher-pupil ratio, percentage of teachers with master’s degrees, average years of experience for teachers, and average teacher salary. The three latter variables were combined into a “career teacher” factor. Both total expenditures per pupil and teacher-pupil ratio were retained as separate variables because of their historically presumed relationships to academic achievement.

Library media center variables submitted to factor analysis were:

- numbers of materials in each possible format (books, periodical subscriptions, videos, software packages, audiovisual materials),
- numbers of microcomputers,
- numbers of media-endorsed staff and of total staff hours in a typical week,
- numbers of weekly hours typically spent assisting teachers and numbers of hours spent collaborating with them in designing instructional units,
- numbers of service transactions (print and nonprint circulation, information skills instruction contacts, instances of microcomputer use), and
- expenditures on materials and equipment.

These sixteen variables were reduced to five, four of which were represented by factor scores resulting from the combination of two or more of the original variables. The fifth—expenditures on materials and equipment—was derived simply by combining the dollar amounts in these two categories.

Surprisingly, numbers of media-endorsed staff and overall collection size were not related and could not be combined. Instead, total staff hours in a typical week and per-pupil holdings of books, periodicals, and videos constituted a factor that was used to represent the staff and collection size of the library media center. This score was named the “library media center size” factor. Media-endorsed staff hours each week and hours library media staff spent assisting and collaborating with teachers constituted a second factor, the “library media specialist role” factor, which taps the instructional role of the library media specialist. Weekly statistics on print and nonprint circulation and information skills instruction contacts constituted a third factor, the “library media center use” factor, which represented the amount of use of library media centers.

Numbers of microcomputers in or under the jurisdiction of the library media center were unrelated to holdings figures, and weekly instructional sessions using microcomputers were unrelated to other kinds of library media center use. Instead, the two figures related to

microcomputers were combined into a fourth factor, the “library media center computing” factor. Predictably, expenditures on library media materials and equipment were strongly related to each other. Because they are both dollar figures, these data were summed into a single amount labeled “library media center expenditures per pupil.”

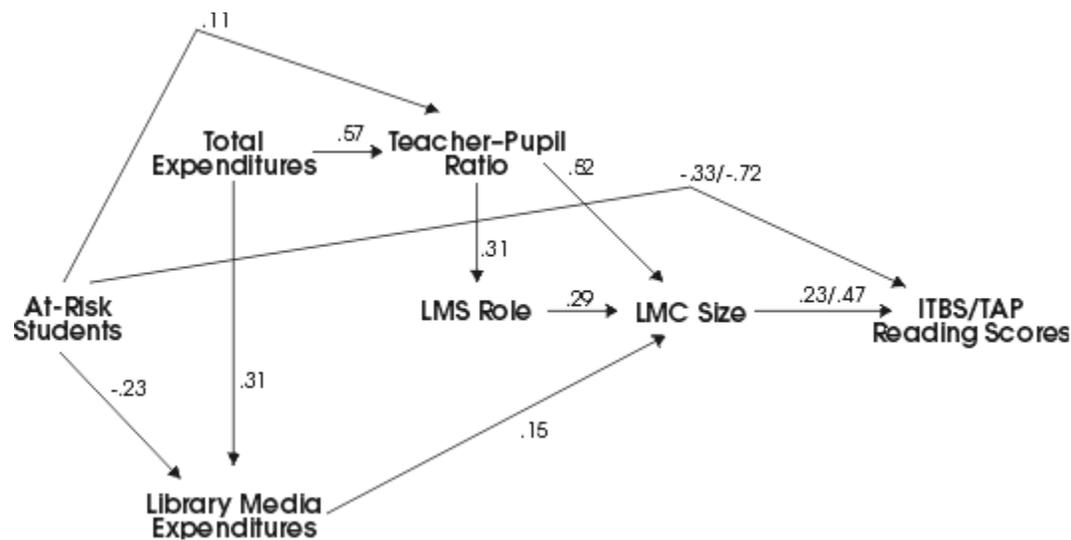
As a result of these three phases of analysis, the original data were thus reduced and refined to produce the nine independent variables that formed the basis for the study’s final analysis:

- Community variable: at-risk factor
- School variables: teacher-pupil ratio, “career teacher” factor, and total expenditures per pupil
- Library media center variables: library media center size factor, library media specialist role factor, library media center use factor, library media center computing factor, and library media center expenditures per pupil

The final analysis involved developing and testing a model that describes the nature of the relationship between each of these variables and the dependent variable—that is, student achievement as defined by students’ ITBS/TAP Reading Scores. In this model, all nine independent variables were considered potential predictors, and all were analyzed in relation to reading scores for students in each of the grades under study (one, two, four, five, seven, and ten).

Regression analysis, the technique used to test the model, is designed to assess the strength and direction of each relationship while at the same time controlling for all the others. As shown in figure 1, the larger the path coefficient, the stronger the impact of the predictor, a minus sign indicates an inverse or negative relationship. For example, the fewer at-risk conditions in a community, the higher the average test score for the school.

Figure 1. The Impact of School Library Media Centers on Academic Achievement: A Path Model



In the preliminary regression analyses, reading scores for almost every grade were predicted by two variables: the at-risk factor and the library media center size factor. The preliminary path coefficients yielded by this analysis are presented in table 2; a second analysis conducted to confirm the effects of these two predictors yielded the path coefficients presented in table 3. The importance of this finding is highlighted by the finding that other variables predicted reading scores for only one or two grades.

Table 2. Preliminary Path Coefficients for At-Risk and LMC Size Factors with Test Scores by Grade

Grade	At-Risk Factor	LMC Size Factor
1st	-.46	.32
2d	-.44	.69
4th	-.33	.35
5th	-.38	.45
7th	—	—
10th	-.72	—

Note: Initially, neither factor demonstrated an impact on academic achievement for the seventh grade, nor did LMC size demonstrate an impact for tenth grade.

Table 3. Final Path Coefficients for At-Risk and LMC Size Factors with Test Scores by Grade

Grade	At-Risk Factor	LMC Size Factor
1st	-.51	.23
2d	-.45	.39
4th	-.33	.35
5th	-.37	.30
7th	-.40	.47
10th	-.72	.27

It would be premature to make too much of the relative size of the path coefficients for the at-risk and library media center size factors, but the patterns they demonstrate do hold some intuitive appeal. At-risk conditions appear to exert great influence as younger students come into the public schools from the community, less influence during the middle years, and even greater influence as older students prepare to leave public schools. In a complementary fashion, library media programs appear to exert more influence during the middle years of schooling. These apparent relationships certainly bear further study.

In addition to generating path coefficients that indicate the relative strength and direction of the relationships between different predictors and reading scores, the multiple regression technique also calculated the percentage of variation in test scores explained by the two direct predictors. These results are presented in table 4. Notably, the at-risk and library media center size factors explained half or more of the variation in reading scores at every grade.

Table 4. Variation Explained by At-Risk and LMC Size Factors

Grade	Percentage of Variation Explained
1st	55
2d	59
4th	48
5th	47
7th	61
10th	76

After identifying and measuring the impact of the two direct predictors, the indirect effects of the other potential predictors were considered. Figure 1 illustrates both the direct and the indirect relationships that were demonstrated through this analysis and highlights the following findings:

- The size of a library media program, as indicated by the size of its staff and collection, is the best school predictor of academic achievement.
- Library media center expenditures predict the size of the library media center's staff and collection and, in turn, academic achievement.
- The instructional role of the library media specialist shapes the collection and, in turn, academic achievement.
- Library media center expenditures and staffing vary with total school expenditures and staffing.
- The degree of collaboration between library media specialist and classroom teacher is affected by the ratio of teachers to pupils.

The other potential predictors analyzed during the study—the career teacher, library media center use, and library media center computing factors—were not found to have significant relationships to student achievement.

Conclusions

These findings provide evidence needed to answer three major questions about the impact of school library media centers on academic achievement.

1. *Is there a relationship between expenditures for library media centers and test performance, particularly when social and economic differences across communities and schools are controlled?* Yes. Students at schools with better-funded library media centers tend to achieve higher average reading scores, whether their schools and communities are rich or poor and whether adults in their community are well or poorly educated.
2. *Given a relationship between library media center expenditures and test performance, what intervening characteristics of library media programs help to explain this relationship?* The size of the library media center's total staff and the size and variety of its collection are important characteristics of library media programs that intervene between library media center expenditures and test performance. Funding is important precisely because its specific purpose is to ensure both adequate levels of staffing in relation to the school's enrollment and a local collection that offers students a large number of materials in a variety of formats.
3. *Does the performance of an instructional role by library media specialists help to predict test performance?* Yes. Students whose library media specialists played such a role tended to achieve higher average test scores.

Limitations

Both the sample and the data involved in this study were subject to limitations that future research should seek to overcome. First, although the study sample fit the profile of public schools in Colorado and the United States by school level, enrollment range, and district setting, it is conceivable that some other important characteristic might distinguish this sample from the universe of public schools it was intended to represent. Additionally, numbers of schools involved in this analysis at upper grade levels were sometimes quite small; a larger overall sample would allow more confidence in the analysis of the data at this level.

These concerns will be overcome as the study is replicated in other states. Any state that requires schools to use the same norm-referenced test(s) and/or to provide library media center data would be a particularly advantageous site for replication.

The study is also limited in terms of its data—both in some that were used and in some that were not available.

- By far the greatest data limitation is the use of standardized tests to operationalize academic achievement. During the time of this study, a revolution in testing has begun across the nation. Future research may enjoy the benefit of more authentic student assessment data against which to analyze the contribution of library media programs to student achievement.
- Subsequent studies will also have the advantage of access to 1990 U.S. Census data on a wide variety of demographic, social, and economic conditions that probably affect academic achievement.
- Other potential school predictors of academic achievement should be considered in future research. Alternative teaching styles, disciplinary issues, and student turnover are just a few such variables for which data were unavailable to this study. The relationships of library media services to the contributions of subject matter areas within the schools should also be addressed.
- Subsequent studies might also consider other library media variables, such as how access to the library media center is scheduled, how information skills are taught, and how technology is used in the library media center.

Next Steps

During the past year, I have made at least eighteen presentations on this study at regional, state, and national events. In several states and among at least one group of states, preparations to replicate the study have begun. Recently, in fact, the AASL organized a committee to encourage and monitor such efforts. The principal investigators are preparing to conduct a follow-up survey of those who have received copies of the study report or attended one of the above-mentioned presentations to determine the impact of the study itself. I urge anyone considering a reciprocation or involved in a replication of the study to notify both myself and the AASL.

References

1. ALA, "Pupil Success Firmly Linked to School Library Funding," *American Libraries* 18, no. 8 (Sept. 1987): 632–33; Mary Jo Lynch and Ann Carleson Weeks, "School Match Revisited," *American Libraries* 19, no. 6 (June 1988): 459–60.
2. Keith Curry Lance, Lynda Wellborn, and Christien Hamilton-Pennell, *The Impact of School Library Media Centers on Academic Achievement* (Castle Rock, Colo.: Hi Willow Research and Publishing, 1993).