Assessing school libraries as learning environments: Examining students' perceptions in third, fourth and fifth grades

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Abstract
This paper presents the full results from a 2008/2009 research study examining the application of a *learning environment* paradigm to the school library setting. The preliminary results from the examination of the Fifth Grade science classes were presented at the IASL 2009 Research Forum. We now report the process of completing our comparative examination of the relationships among student perceptions of science programs and library programs with Third (ages 8 and 9), Fourth (ages 9 and 10) and Fifth (ages 10 and 11) Grades. In addition, we extend the assessment of these relationships to a correlation with student achievement on the standardized State tests for Texas.

Introduction
The purpose of this paper is to report the full results from a 2008/2009 research study that applied a *learning environment* paradigm to the school library setting. Schultz-Jones and Ledbetter reported the preliminary results of this research at the 2009 International Association of School Librarianship (IASL) annual conference. The results from that preliminary investigation indicated that the methodology for assessing a science classroom learning environment could be extended to the school library setting. Student perceptions provide valuable insights into how the library learning environment is operating, and by extension how it could evolve further. With the current assessment of the full results for Third, Fourth, and Fifth grades we complete the comparative examination of relationships between student perceptions of the science program and the library program within their school setting. Additionally, the assessment of these relationships was extended to include a correlation with student achievement results on the Texas state standardized tests. The results of this analysis suggest a worthy model for assessing the contribution of school libraries to the field of education while at the same time contributing to the field of learning environments.

Background
The field of classroom learning environment research can be charted internationally over the past several decades (Goh & Khine, 2002). While this research mainly originated in the USA, it rapidly evolved in Australia and extends now to Asian researchers. The focus of this research is the learning environment as a "social, psychological and pedagogical context in which learning occurs and which affect student achievement and attitudes" (Fraser, 1998a, p. 3).

From the foundational work of research on behaviour by Lewin (1936) and Murray (1938) a notable number of evaluation instruments have been developed to investigate the relationship between how individuals respond to their environment and student learning outcomes (Fraser, 1998b). The range of applications of

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these instruments includes constructivist classroom environments (Taylor, Fraser, & Fisher, 1997), teacher interpersonal behaviour in the classroom (Kent & Fraser, 1997; Wubbels, Creton, Levy, & Hooymayers, 1993), and the evaluation of educational innovations (Ogbuehi & Fraser, 2007; Maor & Fraser, 1996; Martin-Dunlop & Fraser, 2008; Monsen & Frederickson, 2004). The applicability and validity of these questionnaires to an examination of the classroom learning environment has been firmly established.

Despite the breadth and depth of this research the learning environment in a school library setting has not previously been investigated. The school library learning environment is often referenced as a domain that has components similar to the classroom environment. Ballard (2010) refers to this similarity and highlights how the library space is organized and adapted to meet specific needs within the library "as a flexible learning environment capable of simultaneously supporting a variety of groups and activities" (p. 77). While the physical space is an important component of the library environment, it is the arena of personal interaction between school librarians and students that may be most influential in affecting student outcomes. School librarians take responsibility for teaching students the essential 21st Century learning skills they need to succeed using various guidelines (AASL, 2007). Alongside these learning objectives Small, Snyder and Parker (2009) maintain that school librarians "also excite them about the process of learning and stimulate their curiosity through research, technology, and information problem solving" (Introduction). Engendering enthusiasm within a constructivist school library learning environment depends on the personal behaviour the school librarian exhibits. Assessing the relationship between this behaviour and student learning outcomes is another contribution to the research on the positive impact of school libraries on student achievement.

Previous studies located in various states over the past two decades have examined the effect of school libraries on student achievement. The work of Lance and his associates with initial studies in seven states (Lance, K.C., Hamilton-Pennell, C., Rodney, M.J., Peterson, L., & Sitter, C. 2000; Lance, Rodney & Hamilton-Pennell, 2000a, 2000b, 2001, 2002; Lance, Welborn & Hamilton-Pennell, 1997), led to further studies that examined a variety of differences between schools and the school libraries to identify a range of measurable affects on student performance (Callison, 2004; Smith, 2001; Todd & Kuhlthau, 2002). To date, research completed in 18 states has established the relationship between highly staffed, highly funded school libraries with active information literacy programs and student results on state-wide standardized tests (Todd, 2003). Most recently Small, Snyder and Parker (2009; 2010) report on the results of their examination of the impact between New York school libraries and student achievement and motivation. The emphasis on motivation is notable since it moves the discussion towards the relationship between the school librarian and individual students. The results of their qualitative research indicate that school librarians "have an impact on student's research skills development and motivation for research and inquiry" (Summary of Results).

The development of research skills and an orientation towards inquiry-based learning is a challenge faced by school librarians and science teachers. While collaboration between these educational specialists may be reported as underdeveloped (Mardis, 2007), the impact of the skills developed and reinforced within the school library learning environment is worthy of consideration. In particular, it is of interest to develop a correlation between the school librarian in the school library program and the impact of inquiry-based skills on student achievement. Since both the school library and the science classroom offer a constructivist learning orientation, students from these learning environments may offer some related and valuable insights as to how their school classroom and school library learning environment impact their achievement.

Our objectives for this research are:

1. To assess the extent to which the classroom learning environment assessment instrument can be applied to the school library setting;
2. To assess the school library learning environment in relation to the science classroom learning environment;
3. To assess the extent to which an assessment of the school library learning environment can be used to demonstrate a positive impact on student achievement.

Research Setting

The research setting for this study is a K-5 public elementary school in north Texas that provides mathematics and pre-engineering integrated curricula. The school structure and faculty selection were designed to facilitate the delivery of an inquiry-based curriculum. The use of a Research and Design (R&D) Center that functions as a combination library and center for the delivery of a robotics program complements the inquiry focus. The scope of the school library program has therefore expanded to incorporate exploration and design within the robotics context. The R&D Center provides a section of robotics resources, table space for robotics construction and a section of print resources. Computers are housed in a separate technology area, not within the R&D space. Students do not spend scheduled time in the R&D Center. Instruction associated with robotics is delivered in association with the curriculum, while extended literacy instruction remains the responsibility of the classroom teacher.

Method

One of the standard learning evaluation instruments was selected to investigate students' perceptions of their actual and preferred learning environments in the science classroom and the R&D Center. *My Class Inventory* (MCI) provides a valid and reliable instrument for the assessment of students' perceptions of constructivist classroom learning environments and was developed for use at the primary school level for children aged 8-12 (Fraser, 1998c). The MCI is administered in two sittings. The first set of questionnaires focuses attention on the preferred learning environment. Then, following a substantial time gap of several weeks, the second administration provides the same set of questions with attention on the actual learning environment.

The MCI was selected for use with elementary grade students in this study because of its common use in an assessment of science classrooms, and its distinctive ability to characterize the specific dimensions of satisfaction, competition, friction, difficulty and cohesion. These five dimensions relate to and support the development of inquiry based learning, common to both science classrooms and school libraries.

The 25-item MCI delivered the questions in blocks of five items in each of the five climate scales of: Satisfaction, Friction, Competition, Difficulty and Cohesion. The answer format provided was a choice of Yes, Don't Know, or No. The MCI used in the science classroom was modified for the school library setting by replacing the terms "science classroom" with "Research and Design (R&D) Center", and modifying the concept of "doing schoolwork" to "finding resources (such as books and magazines)".

On the MCI, Satisfaction is defined as the feeling of accomplishment and enjoyment with the learning environment. Friction includes conflicts between students and among students. Competition is the perception that if one student wins, others lose. Cohesion is the perception that students are friendly and can work together. The description of the MCI used is provided in Table 1.

Table 1. Description of My Class Inventory (MCI) assessment instrument.

Scale Name	Items Per Scale	Description
Satisfaction	5	Degree to which students enjoy learning and their class.
Friction	5	Degree to which students do not get along or are unfriendly to each other.
Competitiveness	5	Degree to which students compete with classmates.
Difficulty	5	Degree to which students experience difficulty in their learning tasks.
Cohesiveness	5	Degree to which students feel a sense of belonging.

The MCI was administered to 171 elementary school students in regard to their school library and science classroom experiences. The paper questionnaires were administered in two semesters by the Third, Fourth and Fifth Grade science teachers. The MCI for the preferred learning environment in the science classroom was administered in November, 2008 and the MCI preferred for the Research and Design Center was administered in December, 2008. The MCIs for the actual learning environment in the science classrooms and library environment were administered in early May, 2009. The teachers distributed the questionnaires and read the instructions to the students, assuring the students that the answers remain anonymous. The only help that the teachers provided was if a student did not know a specific word. The students were given up to

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20 minutes to complete the questionnaires; they were then collected, sealed in an envelope and delivered to the Curriculum Coordinator.

The researchers obtained all instruments from the Curriculum Coordinator, once in January, 2008 and again in May, 2009. The questionnaires were processed in May, 2009 using Remark Office OMR®, scanning software for collecting and analysing data from plain-paper OMR (optical mark recognition) forms. Then, the data were exported to Excel® spreadsheets for compilation and analysis.

The results focus on the MCI administered to the 63 Third Grade students (ages 8 and 9), 58 Fourth Grade students (ages 9 and 10), and 50 Fifth Grade students (ages 10 and 11). Student demographics for this population are presented in Table 2.

Table 2. Student demographics for Science Classes and R&D Center.

Class	Male	Female	African American	Asian	Hispanic	Native American	Pacific Islander	White	Mixed	Other
3rd Grade Students in Science Class (n = 63) and 3rd Grade Students in R&D Center (n = 63)										
1	11	10	2			1		15	3	
2	11	11	3		2	1		16		
3	7	13	3		1			16		
SubTotal	**29**	**34**	**8**		**3**	**2**		**47**	**3**	
4th Grade Students in Science Class (n = 58) and 4th Grade Students in R&D Center (n = 58)										
1	10	10	1					18	5	
2	10	9	1					12	2	
3	10	9	2	1	2			14		
SubTotal	**30**	**28**	**4**	**1**	**2**			**44**	**7**	
5th Grade Students in Science Class (n = 50) and 5th Grade Students in R&D Center (n = 50)										
1	6	11	2					15		
2	8	10	1	1				16		
3	9	6	1					14		
SubTotal	**23**	**27**	**4**	**1**				**45**		
Total	**82**	**89**	**16**	**2**	**5**	**2**		**136**	**10**	

The data were first analysed against the learning environment dimensions for the science classroom environment and the school library environment, with *t-test analyses* to assess whether the means of the two groups (R&D Center and Science classroom) are statistically different from each other. In the preliminary phase of analyses (Schultz-Jones & Ledbetter, 2009) we applied the *t-test* for analysis of two samples assuming unequal variances to compare the means for the Fifth Grade Preferred R&D environment to the Actual R&D environment and the means for the Fifth Grade Preferred Science environment to the Actual Science environment. In the current phase of analysis, we use the paired samples *t-test* to compare the Preferred R&D environment to the Preferred Science environment and the Actual R&D environment to the Actual Science environment in Third, Fourth and Fifth grades. The purpose of the latest comparison is to see if students perceive a different learning environment in the two places (R&D Center and Science classroom) and actually like some aspects of one more than the other. Additionally, the effect sizes of the comparisons are included. The larger the effect size, the more demonstrative the significance of the comparison.

The second application of data analysis involved using *Pearson r* for a correlation among the scales measured by the MCI and a correlation with the results of the standard state tests for 2009. The individual Student IDs and the matching individual results of the standard state tests for 2009 were obtained from the school district supervisor. In Texas, the Texas Assessment of Knowledge and Skills (TAKS) is used to measure student achievement at various grade levels. Math and Reading are administered every year from third grade to ninth grade. Writing is administered in the fourth and seventh grades and Science in the fifth and eighth grades. These results, as appropriate to the grade levels in this study (third, fourth, and fifth grades), were used in the correlation analyses.

Results

The initial results from the first phase of analysis for Fifth Grade students (Schultz-Jones, & Ledbetter, 2009) indicated that these students wanted a Science classroom and an R&D Center that uses cooperative work rather than competitive operations. Not surprisingly, these students also indicated that they do not enjoy a Science classroom or an R&D Center where friction occurs among or between students.

With the current phase of analysis we find that the latest comparison shows that students perceive a different learning environment in the two places (R&D Center and Science classroom) and actually like some aspects of one more than the other. Third, Fourth and Fifth graders identified that they prefer more difficulty in the Science classroom than in the R&D Center. For the Third and Fourth graders, they preferred more competition in the Science classroom while the Fifth graders perceived more competition in the actual Science classroom. The Fourth graders were notable in perceiving more satisfaction in the Science classroom than in the R&D Center, and more difficulty in the R&D Center than in the Science classroom. Third graders indicated that they prefer and are experiencing more friction in the Science classroom.

t-Test Analyses

Third Grade

For third graders, a greater amount of Friction is preferred in the Science classroom than in the R&D Center ($t = 3.16$). There is a moderate effect size (i.e. the difference between means expressed in standard deviation units) for the Friction scale ($eta^2 = .140$). Also, in the Science classroom, they prefer more Competition ($t = 2.35$) and Difficulty ($t = 2.73$). Table 3 presents these results.

Table 3. Comparison between Third Grade Science Preferred and R&D Preferred MCI using a paired samples t-test.

Scale	Science Preferred Mean	Science Preferred Standard Deviation	R&D Preferred Mean	R&D Preferred Standard Deviation	*t*	*Eta*^{2}
Satisfaction	2.50	0.472	2.62	0.385	-1.60	0.040
Friction	1.46	0.460	1.23	0.376	3.16*	0.140
Competition	1.91	0.587	1.69	0.530	2.35*	0.082
Difficulty	1.50	0.341	1.35	0.294	2.73*	0.107
Cohesiveness	2.46	0.500	2.56	0.441	-1.18	0.022

*α = 0.05; *df* = 62, *n = 63*; *t* critical = 1.99

When third graders identified the actual learning environments, they perceived significantly more Friction in the Science classroom than in the R&D Center ($t = 4.57$) with a large effect size ($eta^2 = .268$). Further, they were more satisfied in the actual R&D learning environment than with their Science learning environment ($t = -3.19$) with a moderate effect size ($eta^2 = .151$), and perceived more Cohesiveness in the actual R&D Center ($t = -2.24$) with a small effect size ($eta^2 = .081$). Differences between the dimensions of Competition and Difficulty were not significant, as shown in Table 4.

Table 4. Comparison between Third Grade Science Actual and R&D Actual MCI using a paired samples t-test.

Scale	Science Actual Mean	Science Actual Standard Deviation	R&D Actual Mean	R&D Actual Standard Deviation	*t*	*Eta*^{2}
Satisfaction	2.33	0.417	2.48	0.369	-3.19*	0.151
Friction	1.70	0.480	1.42	0.385	4.57*	0.268
Competition	2.18	0.572	2.11	0.362	0.953	0.016
Difficulty	1.37	0.464	1.31	0.364	0.928	0.015
Cohesiveness	2.00	0.571	2.18	0.591	-2.24*	0.081

*α = 0.05; *df* = 60, n = 61; *t* critical = 1.99

Fourth Grade

The fourth grade results, as presented in Table 5, show that these students prefer significantly more Competition ($t = 2.734$) and Difficulty ($t = 2.626$) in the Science classroom than the R&D Center, with small effect sizes ($eta^2 = .109$, $eta^2 = .102$ respectively).

Table 5. Comparison between Fourth Grade Science Preferred and R&D Preferred MCI using a paired samples t-test.

Scale	Science Preferred Mean	Science Preferred Standard Deviation	R&D Preferred Mean	R&D Preferred Standard Deviation	*t*	Eta^2
Satisfaction	2.61	0.405	2.66	0.398	-0.743	0.009
Friction	1.26	0.379	1.17	0.366	1.52	0.037
Competition	1.77	0.526	1.55	0.407	2.73*	0.109
Difficulty	1.43	0.307	1.30	0.360	2.63*	0.102
Cohesiveness	2.43	0.521	2.47	0.520	-0.468	0.004

*α = 0.05; *df* = 61, n = 62; *t* critical = 1.99

In the actual learning environment, the fourth graders perceive significantly more Satisfaction in the Science classroom than in the R&D Center ($t = 3.252$), with a moderate effect size ($eta^2 = .161$). They also perceive significantly more Difficulty in the R&D Center ($t = -2.965$) than in the Science classroom, with a moderate effect size ($eta^2 = .138$). Table 6 details the results for Fourth Grade actual perceptions.

Table 6. Comparison between Fourth Grade Science Actual and R&D Actual MCI using a paired samples t-test.

Scale	Science Actual Mean	Science Actual Standard Deviation	R&D Actual Mean	R&D Actual Standard Deviation	*t*	Eta^2
Satisfaction	2.25	0.414	2.44	0.397	-3.25*	0.161
Friction	1.71	0.484	1.63	0.487	1.42	0.035
Competition	2.01	0.492	1.98	0.393	0.529	0.005
Difficulty	1.50	0.448	1.32	0.398	2.96*	0.138
Cohesiveness	1.92	0.528	1.94	0.594	-0.330	0.002

*α = 0.05; *df* = 55, n = 56; *t* critical = 2.00

Fifth Grade

The fifth grade students prefer significantly more Difficulty in their Science classroom ($t = 2.33$). As shown in Table 7 they also prefer significantly more Cohesiveness in the Science classroom than in the R&D Center ($t = 2.37$). Effect sizes are small for both dimensions. Differences between Satisfaction, Friction and Competition were not significant.

Table 7. Comparison between Fifth Grade Science Preferred and R&D Preferred MCI using a paired samples t-test.

Scale	Science Preferred Mean	Science Preferred Standard Deviation	R&D Preferred Mean	R&D Preferred Standard Deviation	*t*	Eta^2
Satisfaction	2.69	0.321	2.72	0.297	-0.593	0.007
Friction	1.21	0.288	1.14	0.270	1.26	0.032
Competition	1.59	0.481	1.52	0.466	0.820	0.014
Difficulty	1.45	0.333	1.29	0.297	2.33*	0.100
Cohesiveness	2.57	0.467	2.31	0.580	2.37*	0.103

*α = 0.05; *df* = 51, n = 52; *t* critical = 2.00

For the fifth grade, results presented in Table 8, students perceive significantly more competition in the Actual Science classroom than in the Actual R&D Center ($t = 3.061$). This scale shows a moderate effect size ($eta^2 = .161$).

Table 8. Comparison between Fifth Grade Science Actual and R&D Actual MCI using a paired samples t-test.

Scale	Science Actual Mean	Science Actual Standard Deviation	R&D Actual Mean	R&D Actual Standard Deviation	*t*	Eta^2
Satisfaction	2.27	0.429	2.40	0.435	-1.61	0.051
Friction	1.57	0.497	1.52	0.476	0.501	0.005
Competition	1.64	0.439	1.92	0.416	-3.06*	0.161
Difficulty	1.36	0.345	1.33	0.431	0.352	0.003
Cohesiveness	2.26	0.536	2.10	0.590	1.35	0.036

*α = 0.05; *df* = 49, n = 50; *t* critical = 2.00

The correlation results are consistent with previous research, indicating that when students perceive more cohesion among classmates, perceptions of Friction and Competition are lessened. The paired samples *t-test* to compare the Preferred R&D environment to the Preferred Science environment and the Actual R&D environment to the Actual Science environment in Third, Fourth and Fifth grades indicated these students perceive different learning environments and like some aspects of one more than the other. The results of the correlation analyses follow.

Pearson r Correlations

Third Grade

Significant correlations reflecting previous research are found (see Table 9) when the Preferred R&D Center learning environment was examined for Third Grade. Students' perceptions of having Satisfaction are negatively correlated with the amount of Competition (r = -0.549), and Difficulty (r = -0.458); and positively correlated with Cohesion (r = 0.657). Competition is negatively correlated with Cohesion (r = -0.4828). Finally, Difficulty is negatively correlated with Cohesion (r = -0.312). In the preferred learning environment students would be more satisfied with less Competition, and Difficulty in their experiences in the R&D Center. These factors are also related to students' perceptions of less Cohesion as Competition, and Difficulty increase. Students would also prefer less Friction for success in Reading (r = -0.396). With regard to Third Grade student achievement Mathematics is positively correlated with Reading.

Table 9. Relationship between Third Grade Preferred R&D Learning Environment and TAKS Test Results.

Variable	1	2	3	4	5	6	7
1. Satisfaction	1						
2. Friction	-.133	1					
3. Competition	-.549**	.116	1				
4. Difficulty	-.458**	.233	.238	1			
5. Cohesion	.675**	-.075	-.482**	-.312*	1		
6. Mathematics	.187	-.249	-.139	-.108	.051	1	
7. Reading	.037	-.396**	-.081	-.152	.031	.614**	1
Means	2.616	1.224	1.694	1.348	2.555	37.43	34.20
Standard Deviation	.3855	.3797	.5344	.2963	.4442	2.766	1.990

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed). n = 61.

Further examination of the Actual R&D Center learning environment in Third Grade also produced significant correlations as reported in Table 10. Students' perceptions of their Satisfaction are negatively correlated with the amount of Friction (r = -0.625), Competition (r = -0.292), and Difficulty (r = -0.365); and positively correlated with Cohesion (r = 0.498). Perception of the amount of Friction is positively correlated with Competition (r = 0.417) and Difficulty (r = 0.451) and negatively correlated with Cohesion (r = -0.521) and Mathematics (r = -0.324). Competition is negatively correlated with Cohesion (r = -0.282). Difficulty is negatively correlated with Cohesion (r = -0.320), Mathematics (r = -0.420), and Reading (r = -0.302). In their actual learning environment Friction, Competition, and Difficulty are also tied to students being less

satisfied with their experiences in the R&D Center. These factors are also consistent with students' perceptions of less Cohesion as Friction, Competition, and Difficulty increase. Again, as with the Third Grade preferred environment, student achievement in Mathematics is positively correlated with Reading (r = 0.632).

Table 10. Relationship between Third Grade Actual R&D Learning Environment and TAKS Test Results.

Variable	1	2	3	4	5	6	7
1. Satisfaction	1						
2. Friction	-.625**	1					
3. Competition	-.292*	.417**	1				
4. Difficulty	-.365**	.451**	.112	1			
5. Cohesion	.498**	-.521**	-.282*	-.320*	1		
6. Mathematics	.058	-.324*	-.104	-.420**	.176	1	
7. Reading	-.103	-.190	.015	-.302*	.022	.632**	1
Mean	2.481	1.416	2.106	1.348	2.161	37.46	34.28
Standard Deviation	.3593	.3855	.3524	.4080	.5781	2.760	1.959

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed). n = 61.

While there were no relationships between the Third Grade TAKS scores and the Preferred Science learning environments, correlations were significant for several scales of the MCI as Table 11 presents. For the third grade science students, there was a negative correlation between Satisfaction and Friction (r = -.666), Competition (r = -.678), and Difficulty (r = -.571). There was a positive correlation between Satisfaction and Cohesion (r = 0.747). Friction was positively correlated with both Competition (r = 0.761) and Difficulty (r = 0.286); there is a negative correlation with Cohesion (r = -.505). Competition was positively correlated with Difficulty (r = 0.355) and negatively correlated with Cohesion (r = -.531). Difficulty is negatively correlated with Cohesion (r = -.508). Finally, there is a positive correlation between Mathematics and Reading (r = 0.638).

Table 11. Relationship between Third Grade Preferred Science Learning Environment and TAKS Test Results.

Variable	1	2	3	4	5	6	7
1. Satisfaction	1						
2. Friction	-.666**	1					
3. Competition	-.678**	.761**	1				
4. Difficulty	-.571**	.286*	.355**	1			
5. Cohesion	.747**	-.505**	-.531**	-.508**	1		
6. Mathematics	.003	-.063	.000	-.013	-.041	1	
7. Reading	.079	-.117	-.023	-.066	.029	.638**	1
Mean	2.502	1.451	1.908	1.495	2.460	37.48	34.11
Standard Deviation	.472	.460	.587	.341	.500	2.588	2.009

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed). n = 62

As shown in Table 12, there were also no relationships between the TAKS scores and the Actual Science learning environments of the Third grade students, but correlations were significant for several scales of the MCI. There was a negative correlation between Satisfaction and Friction (r = -.593), Competition (r = -.436), and Difficulty (r = -.612). There was a positive correlation between Satisfaction and Cohesion (r = 0.555). Friction was positively correlated with both Competition (r = 0.439) and Difficulty(r = 0.493); there is a negative correlation with Cohesion (r = -.461). Competition was negatively correlated with Cohesion (r = -.303). Once again, there is a positive correlation between Mathematics and Reading (r = 0.648).

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Table 12. Relationship between Third Grade Actual Science Learning Environment and TAKS Test Results.

Variable	1	2	3	4	5	6	7
1. Satisfaction	1						
2. Friction	-.593**	1					
3. Competition	-.436**	.439**	1				
4. Difficulty	-.612**	.493**	.101	1			
5. Cohesion	.555**	-.461**	-.303*	-.226	1		
6. Mathematics	.126	.109	.012	-.049	.057	1	
7. Reading	.044	.134	.100	-.117	-.026	.648**	1
Mean	2.318	1.708	2.177	1.393	1.990	37.50	34.08
Standard Deviation	.419	.474	.569	.497	.565	2.614	2.036

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed). $n = 60$

Fourth Grade

In the Fourth Grade a standardized state test for Writing is administered in addition to the standardized tests for Mathematics and Reading. Table 13 reports the significant correlations from the examination of the Preferred R&D Center learning environment in Fourth Grade. Students' perceptions of their Satisfaction are negatively correlated with the amount of Competition (r = -0.550), and Difficulty (r = -0.552); and positively correlated with Cohesion (r = 0.548). Competition is negatively correlated with Cohesion (r = -0.473) and Mathematics (r = -0.382). Difficulty is negatively correlated with Cohesion (r = -0.454) and Reading (r = -0.365). Finally, Cohesiveness is positively correlated with Mathematics (r = 0.274). Reading is positively correlated with Mathematics (r = 0.324) and with Writing (r = 0.267). As with the Third Grade students Competition and Difficulty are tied to students being less satisfied with their preferred experiences in the R&D Center.

Table 13. Relationship between Fourth Grade Preferred R&D Learning Environment and TAKS Test Results.

Variable	1	2	3	4	5	6	7	8
1. Satisfaction	1							
2. Friction	.083	1						
3. Competition	-.550**	.103	1					
4. Difficulty	-.552**	.042	.222	1				
5. Cohesion	.548**	-.079	-.473**	-.454**	1			
6. Mathematics	.245	.090	-.382**	-.062	.274*	1		
7. Reading	.223	-.094	-.159	-.265*	.135	.324*	1	
8. Writing	.008	.021	-.020	-.108	-.014	.251	.267*	1
Mean	2.661	1.165	1.545	1.300	2.474	40.26	38.45	27.19
Standard Deviation	.3977	.3662	.4068	.3599	.5201	1.943	1.818	1.051

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed). $n = 58$.

The Actual learning environment of the R&D Center was also examined for Fourth Grade, and presented in Table 14. Students' perceptions of their Satisfaction are negatively correlated with the amount of Friction (r = -0.500), and Difficulty (r = -0.352); and positively correlated with Cohesion (r = 0.553) and Mathematics (r = 0.324). Perceptions of the amount of Friction are positively correlated with Competition (r = 0.439) and Writing (r = 0.467) and negatively correlated with Cohesiveness (r = -0.363) and Reading (r = -0.298). Competition is negatively correlated with Cohesion (r = -0.271). Reading is positively correlated with Mathematics (r = 0.324) and with Writing (r = 0.267). Friction and Difficulty are tied to students being less satisfied with their actual experiences in the R&D Center. For Fourth Grade students they perceive less Cohesion as Friction and, Competition increase.

Table 14. Relationship between Fourth Grade Actual R&D Learning Environment and TAKS Test Results.

Variable	1	2	3	4	5	6	7	8
1. Satisfaction	1							
2. Friction	-.500**	1						
3. Competition	-.149	.439**	1					
4. Difficulty	-.352**	.467**	.039	1				
5. Cohesion	.553**	-.363**	-.271*	-.117	1			
6. Mathematics	.324*	-.020	.050	-.144	.186	1		
7. Reading	.184	-.298*	-.058	-.208	.226	.324*	1	
8.Writing	-.148	.086	.253	-.128	-.054	.251	.267*	1
Mean	2.410	1.637	1.990	1.322	1.922	40.26	27.19	38.45
Standard Deviation	.4059	.4777	.3867	.4000	.5872	1.943	1.051	1.818

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed). $n = 58$.

Table 15 shows that there was a relationship between the TAKS scores and the Preferred Science learning environments; correlations were significant for several scales of the MCI. For the fourth grade science students, there was a negative correlation between Satisfaction and Friction ($r = -.531$), Competition ($r = -.296$), and Difficulty ($r = -.350$). There was a positive correlation between Satisfaction and Cohesion ($r = 0.520$). Friction was positively correlated with both Competition ($r = 0.563$) and Difficulty ($r = 0.367$); there is a negative correlation with Cohesion ($r = -.651$). Competition was negatively correlated with Cohesion ($r = -.373$). Cohesion was positively correlated with Mathematics ($r = 0.302$). Finally, there is a positive correlation between Reading and Mathematics ($r = 0.324$) and Reading and Writing ($r = 0.267$).

Table 15. Relationship between Fourth Grade Preferred Science Learning Environment and TAKS Test Results.

Variable	1	2	3	4	5	6	7	8
1. Satisfaction	1							
2. Friction	-.531**	1						
3. Competition	-.296*	.563**	1					
4. Difficulty	-.350**	.367**	.178	1				
5. Cohesion	.520**	-.651**	-.373**	-.097	1			
6. Mathematics	.116	-.169	-.118	-.102	.302*	1		
7. Reading	.160	-.114	-.048	-.107	.215	.324*	1	
8.Writing	.029	-.040	-.014	.106	.186	.251	.267*	1
Mean	2.616	1.263	1.775	1.425	2.425	40.26	38.45	27.19
Standard Deviation	.402	.376	.522	.306	.520	1.943	1.818	1.051

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed). $n = 58$

Also for Fourth Grade students there was a relationship between the TAKS scores and the Actual Science learning environments (see Table 16); correlations were significant for several scales of the MCI. There was a negative correlation between Satisfaction and Friction ($r = -.402$), and Difficulty ($r = -.344$). There was a positive correlation between Satisfaction and Cohesion ($r = 0.655$). Friction was positively correlated with Competition ($r = 0.448$) and there is a negative correlation with Cohesion ($r = -.345$). Difficulty is negatively correlated with Mathematics ($r = -.328$). Finally, there is a positive correlation between Reading and Writing ($r = 0.267$).

Table 16. Relationship between Fourth Grade Actual Science Learning Environment and TAKS Test Results.

Variable	1	2	3	4	5	6	7	8
1. Satisfaction	1							
2. Friction	-.402**	1						
3. Competition	-.240	.448**	1					
4. Difficulty	-.344**	.233	.022	1				
5. Cohesion	.655**	-.345**	-.195	-.103	1			
6. Mathematics	.212	.105	-.144	-.328*	-.047	1		
7. Reading	.116	-.082	-.143	-.240	.109	.324*	1	
8.Writing	-.264*	.294*	.093	-.058	-.130	.251	.267*	1
Mean	2.241	1.710	2.021	1.503	1.917	40.26	38.45	27.19
Standard Deviation	.408	.477	.495	.445	.527	1.943	1.818	1.051

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed). *n* = 58

Fifth Grade

Significant correlations were also produced from an examination of the Preferred R&D Center learning environment in Fifth Grade (see Table 17) where a standardized state test for Science is administered in addition to the standardized tests for Mathematics and Reading. Students' perceptions of their Satisfaction are negatively correlated with the amount of Competition (r = -0.443), and Difficulty (r = -0.278); and positively correlated with Cohesion (r = 0.482). Competition is negatively correlated with Cohesion (r = -0.353). Difficulty is positively correlated with Mathematics (r = 0.280). Mathematics is positively correlated with Science (r = 0.465) and Reading (r = 0.370). And Science is positively correlated with Reading (r = 0.327). Competition and Difficulty are tied to students being less satisfied with their experiences in the preferred R&D Center. Students perceive less Cohesion as Competition increases.

Table 17. Relationship between Fifth Grade 5 Preferred R&D Learning Environment and TAKS Test Results.

Variable	1	2	3	4	5	6	7	8
1. Satisfaction	1							
2. Friction	.105	1						
3. Competition	-.443**	-.041	1					
4. Difficulty	-.278*	.078	.160	1				
5. Cohesion	.482**	.051	-.353**	-.220	1			
6. Mathematics	-.122	.166	.132	.280*	-.077	1		
7. Science	-.168	.170	.086	.018	-.010	.465**	1	
8. Reading	-.061	.040	.158	.146	-.044	.370**	.327*	1
Mean	2.737	1.204	1.533	1.270	2.322	42.75	38.64	39.76
Standard Deviation	.2929	.3150	.4514	.2963	.5636	1.385	1.533	2.145

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed). *n* = 54.

An examination of the Actual R&D Center learning environment in Fifth Grade produced the significant correlations reported in Table 18. Students' perceptions of their Satisfaction are negatively correlated with the amount of Friction (r = -0.725), Competition (r = -0.457), and Difficulty (r = -0.459); and positively correlated with Cohesion (r = 0.482). Perceptions of the amount of Friction are positively correlated with Competition (r = 0.433) and Difficulty (r = 0.509) and negatively correlated with Cohesiveness (r = -0.457). Competition is positively correlated with Difficulty (r = 0.466) and negatively correlated with Cohesion (r = -0.336). Difficulty is negatively correlated with Cohesion (r = -0.339). Mathematics is positively correlated with Science (r = 0.464) and Reading (r = 0.330). And Science is positively correlated with Reading (r = 0.338). In the actual learning environment of the R&D Center Friction, Competition, and Difficulty are tied

to students being less satisfied with their actual experiences. As with the Third Grade students these factors are also related to students' perceptions of less Cohesion as Friction, Competition, and Difficulty increase.

Table 18. Relationship between Fifth Grade 5 Actual R&D Learning Environment and TAKS Test Results.

Variable	1	2	3	4	5	6	7	8
1. Satisfaction	1							
2. Friction	-.725**	1						
3. Competition	-.457**	.433**	1					
4. Difficulty	-.459**	.509**	.446**	1				
5. Cohesion	.469**	-.457**	-.336*	-.339*	1			
6. Mathematics	-.073	-.107	.123	.093	-.105	1		
7. Science	-.114	-.108	.124	-.043	-.134	.464**	1	
8. Reading	-.175	.074	.234	.201	-.042	.330*	.338*	1
Mean	2.400	1.518	1.906	1.325	2.102	42.78	38.63	39.92
Standard Deviation	.4308	.4736	.4183	.4289	.5857	1.390	1.549	1.968

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed). $n = 51$.

As reported in Table 19, there was a relationship between the TAKS scores and the Preferred Science learning environments; correlations were significant for several scales of the MCI. For the Fifth grade science students, there was a negative correlation between Satisfaction and Friction ($r = -.581$), Competition ($r = -.455$), and Difficulty ($r = -.342$). There was a positive correlation between Satisfaction and Cohesion ($r = 0.531$). Friction was positively correlated with Competition ($r = 0.453$); there is a positive correlation with Cohesion and Mathematics ($r = 0.346$). Competition was negatively correlated with Cohesion ($r = -.441$). Difficulty was positively correlated with Science ($r = 0.294$), and Cohesion is positively correlated with Mathematics ($r = 0.346$). Finally, there is a positive correlation between Science and Mathematics ($r = 0.455$), and Science and Reading ($r = 0.325$).

Table 19. Relationship between Fifth Grade 5 Preferred Science Learning Environment and TAKS Test Results.

Variable	1	2	3	4	5	6	7	8
1. Satisfaction	1							
2. Friction	-.581**	1						
3. Competition	-.455**	.453**	1					
4. Difficulty	-.342*	.259	.079	1				
5. Cohesion	.531**	-.453**	-.441**	-.073	1			
6. Mathematics	.103	-.280*	.015	-.034	.346*	1		
7. Science	.088	-.202	-.086	.294*	.067	.455**	1	
8. Reading	-.061	-.041	.094	.053	.031	.317*	.325*	1
Mean	2.688	1.208	1.592	1.452	2.568	42.76	38.60	39.88
Standard Deviation	.321	.288	.481	.333	.467	1.393	1.552	1.965

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed). $n = 50$.

The Actual Science learning environments of the Fifth grade students also demonstrate a relationship with the TAKS scores, as Table 20 reports. And, correlations were significant for several scales of the MCI. There was a negative correlation between Satisfaction and Friction ($r = -.401$), Difficulty ($r = -.329$) and Mathematics ($r = -.348$). Friction was positively correlated with Competition ($r = 0.451$) and there is a negative correlation with Cohesion ($r = -.377$). Competition is negatively correlated with Cohesion ($r = -.395$). Finally, there is a positive correlation between Science and Mathematics ($r = 0.455$), Reading and Mathematics ($r = 0.317$), and Reading and Science ($r = 0.325$).

Table 20. Relationship between Fifth Grade 5 Actual Science Learning Environment and TAKS Test Results.

Variable	1	2	3	4	5	6	7	8
1. Satisfaction	1							
2. Friction	-.401**	1						
3. Competition	-.215	.451**	1					
4. Difficulty	-.329*	.165	-.020	1				
5. Cohesion	.157	-.377**	-.395**	.136	1			
6. Mathematics	-.348*	.073	.044	.064	.242	1		
7. Science	-.234	-.142	-.219	.091	.170	.455**	1	
8. Reading	-.160	.009	.039	.071	-.222	.317*	.325*	1
Mean	2.268	1.572	1.644	1.360	2.256	42.76	38.60	39.88
Standard Deviation	.429	.497	.440	.345	.536	1.393	1.552	1.965

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed). $n = 50$.

Discussion

The application of the MCI learning environment assessment instruments to the school library setting indicates that student perceptions can be assessed and does provide insights into the role that the school library plays in affecting student achievement. The results of administering a learning environment evaluation instrument to the school library and the science classroom indicate that it is possible to assess these learning environments in relation to each other.

The prior study found that the Fifth Grade students were more satisfied with their Science classroom learning environment than with the R&D Center learning environment. In the current analysis, the Fourth Grade students indicate that they are more satisfied with their Science classroom learning environment while the Third graders are more satisfied with the R&D Center learning environment, finding significantly more Friction in the Science classroom than in the R&D Center and perceiving more Cohesiveness in the actual R&D Center. Students in Third, Fourth and Fifth grades identified that they prefer more difficulty in the Science classroom than in the R&D Center. And Third and Fourth grade students also indicated that they prefer less competition in the R&D Center as opposed to the science classroom. For Fourth graders, they perceived more satisfaction in the Science classroom than in the R&D Center, and more difficulty in the R&D Center than in the Science classroom.

These results may be reflective of the placement of the robotics program in the Research and Design Center and suggest that students perceive an atmosphere of competition and challenge. Third grade students are not actively involved with the robotics program and the satisfaction they perceive with the R&D Center may be a result of being able to focus on reading resources and activities. For the Fourth and Fifth grade students the robotics program may dominate other research and inquiry activities. This requires further exploration and consideration for application in school library situations where multiple objectives are at play for the use of the learning space.

The correlation between the assessment of the learning environment dimensions, and student achievement on the state standardized tests yielded interesting results. Not surprisingly, correlations demonstrate that Students' perceptions of their Satisfaction correlate negatively with the amount of Friction, Competition, and Difficulty; and correlate positively with Cohesion. However, for Third, Fourth, and Fifth grade student perceptions of their Satisfaction in the R&D Center are negatively correlated with the amount of Friction in the Actual R&D learning environment. This dimension would be worth further consideration since students do not indicate a preference for friction in relation to satisfaction in their Preferred R&D Center.

Correlation results related to reading confirm that across all grade levels regardless of learning environment, there is a positive correlation between reading and mathematics. In the Fourth Grade, reading also holds a

positive correlation to writing. And in the Fifth Grade, reading is positively correlated with science. The value and importance of reading skills applies across the grades and across the curriculum.

The R&D Center does, however, demonstrate some negative correlations where reading is concerned. In the results for the Third Grade Actual R&D, reading negatively correlates to difficulty and in the Fourth Grade Actual R&D reading negatively correlates to friction. Since reading demonstrates a consistent correlation to achievement in mathematics, writing and science the incidence of negative correlations warrant attention. The focus of the robotics activities may distract from reading opportunities and influence other dimensions as well. The report of the negative correlation in the Third Grade Actual R&D Center of friction to mathematics and difficulty to mathematics also suggests a less desirable earning environment for these students. While the students in this school are considered high achievers for the school district, a more positive learning environment in the R&D Center could contribute to higher achievement. For the Science classroom, on the other hand, no negative correlations for reading, writing, mathematics or science were identified. The existence of a robotics program within a school library environment adds an intriguing aspect to this inquiry based learning environment and suggests that it may challenge the acquisition of broader research skills.

The student achievement results also indicate that there is the potential for examining the school library learning environment in relation to specific areas of the curriculum. In addition to considering the influence of the school library on curricular success, a stronger relationship between the R&D Center and the science classroom may benefit students. Additional dimensions to consider would be collaboration between the school librarian and the classroom teacher as well as student knowledge of the information resources available in and through the school library.

Next steps in the research process will include further modification of the learning environment evaluation instrument towards incorporating additional dimensions. And, these attributes could be considered for addition to an existing evaluation instrument that assesses teachers' perceptions of learning environments. Further, the teacher level evaluation instrument will be modified for school librarians to assess complementary perceptions. Future modifications will also address guided inquiry constructs in both the school library and the science classroom.

Instruction and learning are integral to school library programs. Tools that enable constructive assessment of the learning environments associated with these programs could enable improvement of teaching methods and relationships between students and school librarians. This will further contribute to recognition of the strong role of the school library program in the school learning community. The contribution of the school library to student achievement can be demonstrated with statistical measurement and correlation to measured results.

Conclusion

The results of applying the learning environment paradigm to the school library setting indicate that this methodology has validity and can demonstrate the impact of a school library program on student achievement. These results are admittedly preliminary since they reflect one year of data collection. Nevertheless, they do indicate a promising start to identifying what is preferred by students and what is actually occurring. Knowledge of these perceptions could contribute to understanding student needs and lead to improvements in the school library learning environment. The evolution of this learning environment could also include enhanced interaction between school librarians and classroom teachers.

Applying a psycho-social construct and a constructivist learning environment approach to the school library extends the field of learning environment research while also extending the scope of research on the impact of school libraries on student achievement. This new model could enhance an understanding of the contribution of school libraries to the field of education.

Three key learnings:

- The classroom learning environment assessment instrument can be applied to the school library setting.
- The school library learning environment can be assessed in relation to the science classroom learning environment.
- Learning environment assessments can be correlated to student achievement and could guide improvements in the school library environment.

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Statement of Originality

This statement certifies that the paper above is based upon original research undertaken by the author and that the paper was conceived and written by the author(s) alone and has not been published elsewhere. All information and ideas from others is referenced.

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