School building condition, social climate, student attendance and academic achievement: A mediation model

Lorraine E. Maxwell

Cornell University, Department of Design and Environmental Analysis, 3419 Martha Van Rensselaer Hall, Ithaca, NY 14853, United States

Abstract

Research investigating student academic achievement points to the contribution of the physical and social context of schools. Previous studies examined either the physical or social environment. The current study examines the social climate and student attendance as mediators of the relation between the physical environment and academic achievement. Secondary data for 236 NYC middle schools were analyzed using structural equation modeling. The model included: 1) building condition assessed by building professionals, 2) social climate measured by the Learning Quality Survey, 3) school level student attendance rate, 4) standardized math and English Language Arts test scores, 5) percent of student body eligible for free and reduced priced meals, and 6) percent of student body identified as minority. Findings indicate that academic achievement is linked to building condition mediated by the social climate and student attendance. The model accounted for 70 percent of the variance in the outcome measures.

© 2016 Elsevier Ltd. All rights reserved.

1. Introduction

One of the functions of schools is to promote the acquisition of knowledge and skills. Another important function of schools is to transmit societal values and ideas (Fine, Burns, Payne, & Torre, 2004; Rivlin & Weinstein, 1984). These values are communicated in a number of ways including through the school’s social and physical environment. School buildings are public places and therefore represent the communities where they are located. A well-designed and well maintained public building usually indicates that society values the activities that take place in the building and, by extension, the people who use the building. Therefore, the quality of a school building may communicate to the students, teachers, and staff that they are valued and that their activities are important.

Interpersonal relationships amongst a school’s users (students, teachers, staff and parents) are a fundamental part of a school’s social environment (also referred to as the social climate) (Bryk & Schneider, 2002). Through this system of relationships values, expectations and mutual respect are communicated to all of the school’s users. In other words, the social climate of a school is a potentially important contributing factor to student outcomes.

While previous research has examined either the relation of the physical environment or the social environment to student academic outcomes, the premise of this study is that the quality of the social and the physical environment are linked to each other and both are linked to student academic outcomes. In addition, this study examines the possible role of the social climate and student attendance as mediators of the relation between the school’s physical environment and student academic achievement.

2. Theoretical foundation

Place identity theory and the bio-ecological model of human development form the theoretical basis for this investigation. Place identity theory states that children develop a sense of who they are, in part, through interactions with their physical surroundings (Proshansky & Fabian, 1987). Interactions with, and understanding of, the places of their daily lives contributes to children learning who they are. The proximal settings of home, school, and neighborhood are where children spend most of their waking time and therefore play a critical role in child development. These are the places where the child most closely interacts with the physical environment and where important social relationships form with family, teachers, other adults, and peers (Bronfenbrenner & Morris, 1998; Bronfenbrenner, 1979). Relationships with the physical and social environment are the principal context for development. Reciprocal relationships with proximal settings provide additional feedback about the child’s identity.
The school is one of a child's micro-systems (the others are home and neighborhood). During the time a child is in school he or she engages in numerous interactions with other people and with the physical environment. Bronfenbrenner describes these interactions as proximal processes and identifies them as the "engines of development" (Bronfenbrenner, 1979). In school the child interacts with the teacher, other adults, classmates and other peers. The child engages in a variety of activities during the school day including listening, writing, using technology, eating, physical activity, and personal hygiene. Bronfenbrenner's conceptualization of the school as a micro-system implies that there is an interrelationship between all aspects of a school. The activities, social interactions, and physical places are all part of the school as a micro-system.

The physical quality of spaces is often overlooked when designing educational programs intended to improve student learning. Woolner, Hall, Higgins, McCaughey, and Wall (2007) note that the relationship between the physical environment of schools and student outcomes is "multi-factorial" and that possible mediating "chains" should be investigated. The current study examines one possible chain between school buildings and academic outcomes by investigating the relatively under-examined question regarding two mediators in this relationship, school social climate and student attendance.

3. Literature review

Previous research has examined links between the quality of the school's physical environment and student outcomes, as well as the role of the school's social climate in student outcomes. For the purposes of this study, review of the school building condition literature is limited to studies examining architectural/engineering attributes and/or building aesthetic attributes. Next, literature highlighting ways in which the school's social climate is related to student outcomes is summarized.

3.1. School building condition: linkages between school building attributes and student outcomes

3.1.1. General building condition

Significant correlations between negative structural and aesthetic attributes of school buildings and poor student learning and achievement have been documented at the school and district level (Al-Enizi, 2002; Cash, 1993; Earthman, Cash, & Van Burkum, 1995; Hines, 1996; Lewis, 2001; Maxwell, 1999; Boses & Shaw, 2005), Crampton (2009), examining state-wide U.S. national data sets, notes that while human capital (teachers) has the most influence on student achievement, physical capital (school building condition) also makes a significant contribution. Likewise, although student background characteristics such as family SES (as measured by students' eligibility for free and reduced priced school meals) accounts for a portion of the variance for academic achievement scores, studies at the district (Lewis, 2001), state (Tanner, 2009) and national level (Kumar, O'Malley, & Johnston, 2008) found that attributes of school building condition provide additional explanatory power.

In addition to a direct relationship between the physical environment and academic achievement, school building condition may also be related indirectly to academic outcomes. Using school-wide data, student attendance was found to mediate the relation between building condition and English language arts and math standardized test scores in a study of NYC public elementary schools (Duran-Narucki, 2008). Controls were included for ethnicity, family socio-economic status (SES) and teacher quality. Plank, Bradshaw, and Young (2009) call for researchers to more closely examine the effect of physical disorder in schools on student attendance, achievement, and engagement with learning. Their research suggests that the link between physical disorder and academic achievement might be mediated by social disorder, i.e., social climate.

Poor school building condition is also associated with student problem behaviors such as in-school use of alcohol (Kumar et al., 2008), absenteeism and dropout rate (Branham, 2004; Evans, Yoo, & Sipple, 2010), and a sense that they as individuals are not valued by the larger community (Fine et al., 2004). The latter study provides a qualitative examination of students' perceptions of their school environment. On the other hand, while not based on specific empirical findings, Cooper-Marcus and Sarkissian (1993) and Weinstein (1987), suggest that good school building condition can send a positive message to students that they are valued.

Investigations of elementary and high students' perception of school building condition, and objective evaluation of school building condition with controls for family SES, finds that good school building condition predicts student perceived self-worth, perceived academic competency (Simon, Evans, & Maxwell, 2007) and academic achievement and self-efficacy (Maxwell & Schechman, 2012). School building aesthetic attributes may also influence students' perception of academic expectations (Uline, Tschannen-Moran, & Wolsey, 2009) and a desire to spend time in school (Booth & Sheehan, 2008). Design features of a school such as student artwork displayed in public areas and positive classroom décor (i.e., student-created personalized displays) are associated with increased student feelings of self-worth (Maxwell & Chmielewski, 2008; Sanoff, 1995; Weinstein, 1987) and identification with the school (Killeen, Evans, & Danko, 2003). Both Maxwell & Chmielewski, 2008 and Killeen et al., 2003 were empirical studies. Design features related to light, choice, flexibility, connections (corridors), complexity, and color have also been found to be correlated with academic achievement in British elementary schools (Barrett, Zhang, Moffat, & Kobbacy, 2013).

3.1.2. Lighting

As the use of technology in the classroom increases, providing appropriate lighting (natural and artificial) becomes more complex. Factors to consider include amount of light, distribution or balance of light, glare, monotonous lighting, type of light, and flexibility of lighting system (Erwine, 2006). Research has centered on amount of light (illuminance) and type of light (i.e., flicker from fluorescent lighting) because these aspects of lighting are associated with discomfort and can impair performance (Winterbottem & Wilkins, 2009). Although a causal relationship has not been established, researchers have found that good classroom daylighting is associated with improved academic test scores (Heschong Mehone Group, 1999; Plympton, Conway, & Epstein, 2000) and the production of stress hormones that affect the ability to concentrate (Küller & Lindsten, 1992). A well-coordinated and integrated daylighting and artificial lighting system that accommodates all forms of technology used in the classroom benefits student learning and health (Erwine, 2006).

3.1.3. Windows and views

Windows in schools are important for daylight but also because of the views provided to students. For example, views to well-designed landscapes from cafeteria windows may be critical as a restorative feature for students (Matsuoka, 2010). Studies have found a positive association between views of nature and improved academic test scores (Heschong Mehone Group, 1999; Tanner, 2009; Matsuoka, 2010). In a study of over 900 Massachusetts schools researchers found that greater green buffer zones viewed by students through windows were associated with higher English
and math standardized test scores (Wu et al., 2014).

3.1.4. Indoor air quality (IAQ) and climate

Good Indoor Air Quality (IAQ) in schools is determined by controlling the number and amount of potentially hazardous airborne pollutants through proper heating, ventilation and air conditioning (HVAC) systems (Axelrad, 2006). Although a direct link between IAQ and student learning has not been established, IAQ may affect children’s health. In turn, health issues may affect learning and academic achievement since students who are not in good health are more likely to be absent from school. Children’s exposure to poor IAQ has been linked to rising asthma rates and absenteeism (U.S. EPA, 2003). Climate, or thermal conditions, in schools is composed of temperature, relative humidity, and air velocity (Jaakkola, 2006). Students perform better when temperatures are moderate and relative humidity is low (Evans, 2006; Gifford, 2007).

3.1.5. Summary

A general consensus of the literature is that the physical environment of schools, especially schools in less than adequate condition, is linked to student academic achievement, to student behavior, to student perception of themselves, and with the school’s social environment. These findings hold even with good controls for student-related background characteristics indicating that in addition to family socio-economic circumstances, school building condition should be seriously considered for potential consequences related to academic and other student outcomes.

3.2. School social climate: linkages between social climate and student outcomes

The school’s social climate is also an integral part of the learning environment. Bryk and Schneider (2002) point out that the complex network of social relationships in schools (teachers with teachers and administrators, teachers with students, teachers with parents, students with students) is a critical part of the school environment. An extensive review of this literature is outside the scope of this paper (see Thapa, Cohen, Guffey, & Higgins-D’Alessandro, 2013 for a recent review). However, a brief review of the relevant research on the relationship between school climate, academic outcomes, student behavior and socio-emotional outcomes follows.

The social climate of a school or classroom can be defined as the agreed upon norms and expectations of the school community which are either stated explicitly or implied. School climate can make an important contribution to student outcomes. Studying school social climate presents some methodological problems because of measurement issues (Thapa et al., 2013; Anderson, 1982; Zullig, Koopman, Patton, & Ubbs, 2010). However, research generally focuses on the following topics, safety (including order and discipline), academic press (teaching and learning), social relationships or relational trust (relations between and amongst students, teachers, administrators and parents), school connectedness (relations with the community), and school facilities (cleanliness, order); Cohen, 2006; Freiberg, 1999; Cohen, McCabe, Michelli, & Pickeral, 2009).

3.2.1. Academic outcomes

Moos (1979) pioneering work found a school climate that combines a warm and supportive relationship between teachers and students with an emphasis on scholastic goals and clearly stated expectations fosters student academic achievement. Recent work provides confirmation. In elementary schools, students’ perception of social climate predicts language arts, math and science achievement levels (Esposito, 1999; McMahon, Wernsman, & Rose, 2009). There are a number of studies that examined the association of school climate and academic outcomes at the secondary level (middle school and high school) (Bryk & Schneider, 2002; Gregory & Cornell, 2009; Hoy & Hannum, 1997; Phillips, 1997; Ryan & Patrick, 2001; Shouse, 1996). Academic self-efficacy was found to mediate the relation between school climate and academic outcomes (Høigaard, Kovac, Øverby, & Haugen, 2015). The academic press (academic expectations, part of school climate) of Chicago schools influenced social support of students in their learning of English and math (Lee & Smith, 1999). These associations hold in spite of family background variables; in fact, school climate may provide some protection for students from difficult family situations. For example, perception of school climate was a moderator for ninth and eleventh grade students with respect to the relation between family structure and grade point average (GPA) (O’Malley, Voight, Renshaw, & Eklund, 2015). Students with a more positive perception of school climate reported higher GPAs and the effects were strongest for those from one parent families and homeless situations.

3.2.2. Socio-emotional and behavioral outcomes

School climate is associated with self-efficacy (Høigaard et al., 2015), internalizing and externalizing problems for middle school students (Kuperminc, Leadbeater, & Blatt, 2001; Kuperminc, Leadbeater, Emmons, & Blatt, 1997), social adjustment of elementary school-aged children (Esposito, 1999), self-esteem/self-perception (Cohen et al., 2009; DeWitt et al., 2000) and school level violence (Welsh, 2000). Positive perceptions of school climate are associated with better attendance for high school students (Cohen et al., 2009; Phillips, 1997), lower suspension rates (Gregory, Cornell, & Fan, 2011), less delinquent behavior such as bullying (Gottfredson, Gottfredson, Payne, & Gottfredson, 2005) and high school graduation rates (Thapa et al., 2013).

3.2.3. Gender and ethnic differences

Researchers have found gender and racial/ethnic differences in student perception of, and response to, school climate. Girls may be more likely than boys to perceive a positive school climate (White, LaSalle, Ashby, & Meyers, 2014) except for African American middle school girls who tend to perceive school climate more negatively than white male students (Watkins & Abec, 2009) or white female students (Kuperminc et al., 1997). While, in general, African American students tend to report lower perceptions of school climate (White et al., 2014), when African-American boys perceived a more positive school climate they had fewer teacher-reported externalizing behaviors such as aggression (Kuperminc et al., 2001).

3.3. Middle school

The fit between the school environment and students’ developmental needs is especially critical for middle school students (Eccles et al., 1993; Kuperminc et al., 2001). Young people between the ages of approximately 11 and 14 are transitioning from childhood to adolescence, thereby experiencing changes in their socio-emotional and physical development at the same time that they experience a major change in their school environment (Kuperminc et al., 1997). The transition from the supportive environment of elementary school to the less personal and more competitive environment of middle school comes at a time when young people are also in an intense period of self-definition. A school climate where rules and expectations are clearly defined, students feel safe, academic excellence is supported, and communication patterns amongst students, teachers and parents indicate mutual respect can provide a developmentally appropriate supportive
environment for middle schoolers. The current study investigates the relationship between the school's physical environment, social climate, and student outcomes at the middle school level.

4. Current study

The school physical environment literature and the school climate literature both point to the role that “context” of the school as a micro-system plays in student outcomes (Bronfenbrenner & Morris, 1998). While each body of literature suggests possible pathways (mediators) whereby the context of school interacts with student characteristics (moderators) resulting in a range of student outcomes, few have posited how the physical environment and the school climate might be related. The broken window theory asserts that physical disorder at the neighborhood level affects the extent to which residents are willing to organize for social action or control which leads to further physical deterioration of the neighborhood and an increased opportunity for criminal activity to flourish (Wilson & Kelling, 1982). In other words, if physical features of a neighborhood are not well maintained members of the community are postulated to develop a sense of helplessness, and are unwilling or unable to maintain social order and positive social relationships, i.e., positive social climate. A link found between building condition (physical disorder) and school climate (social disorder) in middle schools (Plank et al., 2009), and building condition and student behavior (attendance and dropout rate) (Branham, 2004) suggests that the broken window theory is useful for school settings. Further examination suggests that school social climate might mediate the relation of building condition and academic outcomes (Uline & Tschanne-Moran, 2008). Student attendance (Duran-Narucki, 2008; Evans et al., 2010) and lateness (Branham, 2004) have also been found to be related to school building condition.

The current study examines the context of the school microsystem by investigating how social climate and student attendance are related to school building condition and to each other in ways that could affect academic achievement. The model hypothesizes that student perception of the school’s social climate (potential social disorder) and student attendance will mediate the relation between school building condition and academic achievement (see Fig. 1). The study acknowledges previous work by including both school social climate and student attendance in the same model. Durán-Narucki’s 2008 study begins to describe the relation between school building condition and student achievement by identifying attendance as a mediator. The current study posits another mediator in the model that will further identify the mechanism through which school building condition is related to student achievement. The model in this study uses the same school district and school building condition data source as the 2008 study, but is investigated for middle schools (grades 6, 7 and 8) because of the importance of better understanding this transitional developmental period.

The model consists of the following hypotheses:

1 - Better ratings of school building condition will directly predict higher student ratings of school social climate.
2 - Higher ratings of school social climate will predict lower student absenteeism rates.
3 - Lower absenteeism rates will directly predict higher achievement test scores.
4 – Better ratings of school building condition will indirectly predict higher standardized achievement test scores.

Student family income represented by percentage of students eligible to receive free or reduced priced school meals and student race/ethnicity are included in the model as controls.

5. Method

5.1. Constructs and measures

5.1.1. Sample

Data was recorded for schools containing grades 6, 7 and 8 (middle schools) of which there are 292 schools across all five boroughs, Manhattan, the Bronx, Brooklyn, Queens and Staten Island. Only self-contained middle schools were used in the analysis. Therefore schools that included any of these grade levels in combination with other grade levels (i.e. kindergarten through 8th grade or 7th, 8th and 9th grades) were excluded reducing the final sample to 236 schools representing a total of 143,788 students.

5.1.2. Measures

Secondary data were used for this study. The NYC Department of Education maintains a website with school facility and academic performance information about every public school in its jurisdiction. For this study the Architectural, Mechanical, and Electrical Inspection reports of the 2011 Building Condition and Assessment Survey (the survey is conducted every five years), the 2011 Learning Quality Survey and the 2011 New York State School Report Card were used.

The independent variables in the model were:

1. Building condition (BuildCond) - The physical environment measure was based on the Building Condition and Assessment Survey prepared by the New York City School Construction Authority. The survey was conducted by independent professionals in architecture and mechanical and electrical engineering. Building attributes are scored from 1 to 5 with 1 indicating good condition and 5 indicating poor condition. A measure was created for this study based on the three reports of the Building Condition and Assessment Survey. A total of 23
items were included in the measure according to the following criteria: (1) the item was used in the Duran-Narucki (2008) study that found school building condition predicted standardized test scores in a sample of Manhattan public elementary schools; (2) the item represented an attribute of the school that users (students) would notice. This could be an aesthetic item such as peeling paint or an architectural or engineering structural item such as a leaking roof. For example, a leaking roof might result in water stains on the ceiling; (3) the item represented a room or facility that was common to the majority of the schools. The items included in the measure are listed in Table 1.

A total score for all items was entered for each school. A total score of 23 indicates that all items in the school were rated in poor condition. M = 58.7, SD = 4.6 (range = 28.8–69.8) and the alpha for the scale is 0.76.

2. School’s social climate (SocClim) — The school’s social climate was assessed by the Learning Quality Survey available on each school’s web page. There are three separate surveys (one for each user group, parents, students and teachers) but each survey requests the users’ opinion on the same five subscales, academic expectations, communication, engagement, safety and respect, topics that relate to academic progress and social relationships and are covered in the school climate literature. Every year since 2007, parents, teachers, and students in grades 6 through 12 take this survey. The survey aids school leaders in assessing how each segment of the school community perceives their school’s learning environment. It is the largest such survey in the United States and is used by the NYC Department of Education to assess each school’s annual progress along with other indicators.

For the purposes of this study only the student survey responses were used. According to information provided by the NYC Department of Education website, students complete the survey in school, usually during class time. The student responses are confidential. The 41 items are scored from one to ten with ten being the most favorable response (see Fig. 2 for all items on the measure). The school’s mean score for each item is reported on the website. For example, under academic expectations on the student survey from one school the mean score for the question “my teachers encourage me to succeed” was 8.7. This indicates that most students in this school agree that teachers maintain high academic expectations. The measure used in the analysis was created by combining all of the scores for each of the five subscales. The subscales were checked for internal consistency. The alpha scores for the subscales indicate internal consistency and reliability: academic expectations = 0.95, communication = 0.90, engagement = 0.96, safety = 0.97, and respect = 0.97. A total Social Climate score was created and used in the analysis. M = 307.7, SD = 28.2 (range = 238–401) and the reliability for the composite scale was alpha = 0.95.

3. Attendance (Attend) — A school-wide attendance (or absenteeism) rate was taken from each school’s New York State School Report Card which is accessed from its webpage and represents the average percentage of days that students attended school. M = 93.5, SD = 2.9, (range = 84.3–98.9).

The two dependent variables in the model were:

Academic achievement (ELA scores and Math scores) - The New York State Report Card report card lists scores on the state-wide standardized mathematics and English language arts examinations and is accessed from each school’s webpage. The test scores are reported on the basis of level one through four. Students scoring at level three or above are considered at grade level and meet the proficiency standard for that subject area. The percentage of students scoring at level three or above was recorded for each school. The mean percentage for all schools was 48.7%, SD = 21.1for the English Language Arts exam (range = 10–100%) and 34.3% for the English Language Arts exam (range = 4.7–97.3%) (see Table 2).

5.2. Analysis

The analysis was done at the school level. First order correlations were obtained (see Table 3). Structural equation modeling (SEM) (Bryne, 1994; Kline, 1998) as part of the SPSS analysis package was used to test the four hypotheses represented by the model. SEM was chosen as the analysis method because it allows for testing the fit of a hypothesized model to the data and can compare contrasting models to determine whether a particular model fits the data better than other models. Full information maximum likelihood estimation method was used to handle missing data. The maximum likelihood estimation method of handling missing data makes use of all available data points (Little & Rubin, 1990).

The fit was assessed with the chi-square test as well as the RMSEA test (root mean square error of approximation) and the CFI (comparative fit index). The standard for accepting a model is an RMSEA of < 0.10 at a minimum but preferably < 0.05. For the CFI,
Academic expectations

The adults at my school help me understand what I need to do to succeed in school.
My teachers encourage me to succeed.
I need to work hard to get good grades at my school.
Students who get good grades in my school are respected by other students.
My school helps me to develop challenging academic goals.
Someone at my school helps me understand what courses I need to be promoted to the next grade or graduate.
My teachers expect me to continue my education after high school.

Communication

Most of the teachers, counselors, school leaders, and other adults I see at school every day know my name or who I am.
On a scale of 1 to 4, how comfortable are you talking to teachers and other adults at your school about: a problem you are having in class? Something that is bothering you?
In how many of your classes during the past two weeks have you: worked in groups of 2 to 6 students?
How many of your classes in the past two weeks have you: had whole class discussions? Participated in hands-on activities such as science experiments?

Engagement

I feel welcome in my school.
The adults at my school look out for me.
My school offers a wide enough variety of classes and activities to keep me interested in school.
Students with disabilities are included in all school activities.
My teachers enjoy the subjects they teach.
My teachers inspire me to learn.
My teachers give me extra help when I need it.
My teachers connect what I am learning to life outside of the classroom.
On a scale of 1 to 4, how available are teachers and other adults at your school to talk about: a problem you are having in class?
Something that is bothering you?

Safety and Respect

Teachers in my school treat students with respect.
Adults in my school treat each other with respect.
Most students in my school help and care about each other.
Most students in my school just look out for themselves.
Most students in my school treat each other with respect.
I stay home because I don’t feel safe at school.
Students threaten or bully other students at school.
Students get into physical fights at my school.
Adults at my school yell at students.
Students in my school are harassed or threatened based on race, color, creed, ethnicity, national origin, citizenship/immigration status, religion, gender, gender identity, gender expression, sexual orientation or disability.
Students use alcohol or illegal drugs while at school.
There is gang activity in my school.
There is a person or program in my school that helps students resolve conflicts.
Discipline in my school is fair.
I am safe in my classes.
I am safe in the hallways, bathrooms, and locker rooms at my school.
I am safe on school property outside my school building.
My school is kept clean.

Fig. 2. NYC school student survey.

Table 2

Means for all variables.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building condition</td>
<td>58.7</td>
<td>4.6</td>
<td>28.8–69.8</td>
</tr>
<tr>
<td>SocClim</td>
<td>307.7</td>
<td>28.2</td>
<td>238–401</td>
</tr>
<tr>
<td>Attendance Rate</td>
<td>93.5</td>
<td>2.9</td>
<td>84.3–98.9</td>
</tr>
<tr>
<td>PerMinority</td>
<td>78.9%</td>
<td>27.1</td>
<td>4–100%</td>
</tr>
<tr>
<td>FreeMeals</td>
<td>80.1%</td>
<td>17.1</td>
<td>0–100%</td>
</tr>
<tr>
<td>ELA scores</td>
<td>32.4%</td>
<td>19.53</td>
<td>4–93.7%</td>
</tr>
<tr>
<td>Math scores</td>
<td>48.7%</td>
<td>21.11</td>
<td>10–100%</td>
</tr>
</tbody>
</table>

Good – 1.00 to Poor – 5.00

Table 3

Pearson correlations.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>0.91**</td>
<td>0.35**</td>
<td>–0.24**</td>
<td>–0.76**</td>
<td>–0.56**</td>
<td>0.78**</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>0.27**</td>
<td>–0.22**</td>
<td>–0.75**</td>
<td>–0.68**</td>
<td>0.73**</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>–0.25**</td>
<td>n. s.</td>
<td>–0.14*</td>
<td>0.34**</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.18**</td>
<td>0.24**</td>
<td>–0.24**</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.61**</td>
<td>–0.66**</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>–0.43**</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**p – 0.01, *p – 0.05, n. s. not significant.
0.90 is considered a good fit. The chi-square is used to test significance but is sample dependent and significance does not necessarily indicate a lack of fit if the other criteria (RMSEA and CFI) for fit are met.

6. Results

Model A examines the relation between school building condition, student perception of the school’s social climate, student attendance and standardized English Language Arts test scores. The chi-square for this model is 5.92 (6, N = 236), p = 0.433. The RMSEA = 0.000 and the CFI = 1.000 indicating a good fit (see Table 4 and Fig. 3). The entire model explains 72% of the variance in the outcome measure, English Language Arts test scores (squared multiple correlations in AMOS). Student attendance explained 48% of the variance.

Model B examines the relation between school building condition, student perception of the school’s social climate, student attendance and standardized math test scores. The chi-square for this model is 13.86 (6, N = 236), p = 0.031. The RMSEA = 0.075 and the CFI = 0.986. The CFI statistic is in the acceptable range and the RMSEA indicates a reasonable fit (See Table 5 and Fig. 4). The entire model explains 70% of the variance in the outcome measure, math scores. Student attendance explained 48% of the variance.

7. Discussion

The findings indicates that a path from school building condition to academic achievement is mediated by student perception of the school’s social climate and student attendance. Each of the four hypotheses are supported by the model; school building condition indirectly predicted student test scores, better school building condition predicted higher student assessment of school social climate, higher ratings of school social climate predicted lower student absenteeism which in turn predicted higher standardized test scores.

While the entire model, which included percent minority students and percent eligible for free and reduced priced meals, accounted for at least 70% of the variance for each outcome measure it should be noted that student attendance accounted for 48% of the variance. This link between student attendance and performance on standardized tests is not surprising. If students are absent they will not receive the benefit from instruction. Students may be absent for a variety of reasons including illness and family situations. However, as this study indicates, absenteeism may also be linked to school building condition and students’ perception of the social climate, which includes academic expectations. A link between school building condition and student absenteeism was found by other researchers (Durán-Narucki, 2008; Branham, 2004).

Results

<table>
<thead>
<tr>
<th>Standardized Direct Effects estimates, p = 0.000, N = 236</th>
</tr>
</thead>
<tbody>
<tr>
<td>BuildCond → SocClim = −0.25</td>
</tr>
<tr>
<td>SocClim → Attend = 0.26</td>
</tr>
<tr>
<td>Attend → ELA scores = 0.39</td>
</tr>
<tr>
<td>Percent minority → Attend = −0.63</td>
</tr>
<tr>
<td>Percent minority → ELA scores = −0.32</td>
</tr>
<tr>
<td>Percent free meals → ELA scores = −0.30</td>
</tr>
<tr>
<td>Standardized Indirect Effects estimates</td>
</tr>
<tr>
<td>BuildCond → ELA scores = −0.03</td>
</tr>
<tr>
<td>Percent minority → ELA scores = −0.25</td>
</tr>
<tr>
<td>SocClim → ELA scores = 0.10</td>
</tr>
</tbody>
</table>

*a* Building condition scores 1 = Good to 5 = poor.

Fig. 3. Model for links between school building condition and standardized English Language Arts test scores.
Expectations and social support has been cited by other researchers as predicted academic achievement. A combination of academic expectations, with attendance as a mediator, indirectly study student perception of social climate (which includes academic achievement test scores in the expected direction. However, school building condition, student perception of the social climate, and attendance were still statistically significant indicating a strong model. The model accounted for 70% of the variance in the math outcome measure and 72% of the variance in the ELA outcome measure indicating a strong model.

7.2. Limitations

This study examined only one school district in a major urban area so the findings may not be generalizable to other districts, especially suburban or rural districts. It was also based on secondary data reported at the school level. Individual student responses to the social climate survey (Learning Quality Survey) and individual student achievement test scores were not available. There could be significant within school variation for both measures.

Other limitations are based on the available data. Student background data was limited. The study did not have access to information about gender or family characteristics other than eligibility for free or reduced priced meals. Additionally, the only measure we have of student learning is scores on standardized tests. While these data are most often used in similar studies, there are other ways to measure student learning and student achievement that could be incorporated into future research.

Finally, due to the cross sectional nature of this study causal contribution to a lack of trust on the part of students and a sense that the school community does not have their best interests at heart. If students come to these conclusions about their school they may have little interest in attending.

The model also supports previous research concerning the relation of school climate to academic achievement. In the current study student perception of social climate (which includes academic expectations), with attendance as a mediator, indirectly predicted academic achievement. A combination of academic expectations and social support has been cited by other researchers as being associated with better student achievement (Bryk & Schneider, 2002; Gregory & Cornell, 2009; Høigaard et al., 2015; Hoy & Hannum, 1997; Lee & Smith, 1999; O'Malley et al., 2015; Phillips, 1997; Ryan & Patrick, 2001; Shouse, 1996; Uline & Tschannen-Moran, 2008).

The model includes the percentage of minority students in the school and percentage of students eligible to receive free or reduced priced meals as controls. Both were significantly related to achievement test scores in the expected direction. However, school building condition, student perception of the social climate, and attendance were still statistically significant indicating as Brokover et al. (1978) pointed out that SES and race/ethnicity alone should not be used to sufficiently explain academic achievement.

In addition, there was no direct or indirect link between percentage of students receiving free or reduced price meals and student attendance. This association was tested in an earlier model and found to be non-significant. Therefore, the model is not included. Importantly, there was also no direct link with either of these student characteristics and perception of the school's social climate. This suggests that irrespective of students’ ethnic/racial and income background, the condition of the school building makes a significant contribution to students’ view of the school's social climate.

7.1. Strengths

Specific strengths of this study relate to the measurement of two independent variables and conceptualization of the model. The study avoided the issue of mono method bias. Assessments of the school social climate and the school building condition were from two different sources. Students assessed the former and building professionals assessed the latter. The Learning Quality Survey, the social climate measure, did not include students’ perception of the physical condition of the school therefore we have an objective measure of the physical environment that is not tied to the perception of the social environment/climate. The study uses a three-way path mediation model (Taylor, MacKinnon, & Tein, 2008). This permits the inclusion in one model two possible mediators, social climate and student attendance that had previously been investigated separately as mediators of school building condition and academic achievement. An additional strength is the amount of variance in the outcome measures accounted for by the model. The model accounted for 70% of the variance in the math outcome measure and 72% of the variance in the ELA outcome measure indicating a strong model.

Table 5

<table>
<thead>
<tr>
<th>Standardized direct effects estimates, p = 0.000 N=236</th>
</tr>
</thead>
<tbody>
<tr>
<td>BuildCond → SocClim → Math scores = −0.25</td>
</tr>
<tr>
<td>SocClim → Attend → Math scores = −0.26</td>
</tr>
<tr>
<td>Attend → Math scores = 0.47</td>
</tr>
<tr>
<td>Percent minority → Attend = −0.63</td>
</tr>
<tr>
<td>Percent minority → Math scores = −0.38</td>
</tr>
<tr>
<td>Percent free meals → Math scores = −0.105 (p = 0.022)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standardized indirect effects estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>BuildCond → Attend → −0.07</td>
</tr>
<tr>
<td>BuildCond → Math scores = −0.03</td>
</tr>
<tr>
<td>Percent minority → Math scores = −0.29</td>
</tr>
<tr>
<td>SocClim → Math scores = 0.12</td>
</tr>
</tbody>
</table>

* Building condition scores 1 = Good to 5 = poor.
relations are not established. The SEM model explains possible mechanisms for how school building condition affects student academic achievement. Variables in the model were included based on previous research. In addition, as with much of the work in this area, this study is not prospective or longitudinal. The data represent one snapshot in time.

7.3. Future research

Future studies should incorporate a multi-level analysis of the school as a micro-system looking at individual students and students within the classroom and school. This would entail significant logistical challenges given that access to individual student data is tied to student turnover. Nevertheless, it would increase understanding of how individual classroom conditions (social climate and physical conditions) combined with school-wide conditions work together to affect student learning. In addition, although large scale qualitative studies are expensive and time consuming, individual interview and/or focus group data would shed more light on students’ daily experiences in the school and classroom. In keeping with Bronfenbrenner’s bio-ecological model (1979) attributes of children’s meso-system namely, students’ family and neighborhood life, should be included in future research. Additionally, physical attributes of the school neighborhood, in particular noise levels, should be included in future studies. Many New York City schools may be affected by a variety of noise sources such as road traffic (trucks, emergency vehicles), elevated subways, and airports. In other communities schools may be affected by only one of these sources.

More longitudinal and prospective work is needed on this topic. Future studies should look at several years of data for each school to determine the stability of the perception of the social climate. In addition, while several age groups are represented in the data, given the way the Learning Quality Survey scores are reported (by school, not by grade) analyses in the current study could not be done based on student age or grade. Future work could look at possible age differences in assessments of school social climate. Future studies should also investigate other possible mediators of school building condition and academic achievement.

8. Conclusions and implications

While the relationships between school building condition and academic achievement remains a complex one, this study helps to further our understanding of the school as a micro-system and specifically, mechanisms by which the physical environment can impact a school’s learning environment. Bryk and Schneider (2002) point out that the quality of social relations in a school sets the stage for other activities that need to happen to improve learning. The social climate measure used in this study (the Learning Quality Survey) assessed aspects of school social relations and therefore scores on this measure represent students’ perception of their school’s social relationships, i.e. social climate. Perhaps student perception of a positive school climate fosters an atmosphere of mutual respect, and therefore a willingness to engage with each other in ways that are productive for learning. In this study the quality of the physical environment was linked with the quality of the social environment. As a micro-system, the activities that occur in a school are shaped by the physical space, the people using the space and the culture (i.e., social climate) of the school. In this theoretical framework we see that it is not enough to examine separately how the physical environment affects student learning or how the school social climate affects student learning. These attributes of the school are intertwined and this study pulls together the school building quality literature and school climate literature. As suggested by both the bio-ecological model (Bronfenbrenner & Morris, 1998), and place identity theory (Proshansky & Fabian, 1987) student learning is not only shaped by individual characteristics (ethnicity, family income, individual potential) but also by the multiple ways in which the school communicates that learning and achievement is possible and important.

The findings from this study provides further support for maintaining school buildings in good condition in all communities as an essential part of providing a quality education for all children. According to a National Center for Education Statistics 2005 survey 10%, or 8100 schools, of the nation’s public schools report that the physical condition of their facilities interferes with instruction to a moderate or major extent (NCES, 2012). This study, therefore, is of potential interest to all U.S. school districts. However, given that the secondary data source for this study was the New York City school district, these findings should be of particular interest to the administrators and educators of that district. The findings will be specifically shared with the district.

The school building condition situation is especially critical for schools with more than 50% of the student body eligible for free and reduced priced meals. In this category 27%, or 9350 schools, report moderate or major physical condition problems that interfere with instruction (NCES, 2012). Schools with a high percentage of students eligible for free or reduced priced meals generally report lower standardized test scores than schools with students from more affluent families. In the current study the percentage of minority students (African American or Black and non-white Hispanic) and those eligible for free and reduced priced meals was positively correlated with poor school building condition. School building condition may be an even more important contributing factor to learning for these students given the relation between school building condition and academic achievement. It is important to fix the “broken window” before it becomes a symbol of deterioration of not only the building, but also of the total learning environment. Students cannot learn if they do not come to school. The physical and social environment both play a role in encouraging attendance, learning, and achievement.

Acknowledgements

I wish to thank the graduate and undergraduate student research assistants who worked on this project Min Moon, Eunhwa Yang, Erica Weiner and Kaitlin Atlas. I also wish to acknowledge the assistance of Francoise Vermeylen regarding data analysis. I am grateful to Gary W. Evans, Nancy M. Wells, and Nicole Simon for their very helpful comments on earlier drafts of this paper. This research was supported by the College of Human Ecology, Cornell University.

References


