ABSTRACT

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The goal of this study was to examine the influence of school ecology, milieu, social system, and culture on public high school student achievement. Utilized data from the ELS:2002 restricted-use dataset, a series of multilevel model analyses were conducted. The results indicate that performance gaps exist between 12th-graders of different ethnicities and socioeconomic backgrounds, but they are merely reflections of the differences that already existed two years prior in 10th-grade. Further, the gap between high and low achieving students becomes narrower from 10th-grade to 12th-grade. The highest mathematics course taken in 12-grade produces a positive estimate of mathematics achievement in 12th-grade, and ethnic minority and lower SES students are less likely to be enrolled in the advanced level courses.

Contradicting to the classic view of school influences on achievement, public high schools exhibit relatively little variability in mathematics performance after controlling for student individual characteristics. Among all school climate variables, school average prior mathematics achievement is significantly positively associated with later mathematics achievement. The nonsignificance of contextual effect, however, suggests that the differences across schools do not matter; rather, the differences among students do. Students in schools locating in economically disadvantaged communities make more gains in advanced mathematics course-taking than their peers in more affluent schools.

The gap between high and low-achieving students grows slightly wider in schools locating in more affluent communities, but becomes slightly narrower in fully computerized schools. Contradicting to most existing findings, school size, noisy environment, quality of light, ethnic composition, teacher certification rate, counselor-student ratio, safety concern, student civility, and general positive climate do not show significant influence on achievement. Suggestions about implications and limitations are provided.

SCHOOL CLIMATE AND PUBLIC HIGH SCHOOL STUDENT ACHIEVEMENT

By

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Chapter 1

Introduction

The education required by the mix of jobs in the United States have increased (Autor, Levy, & Murnane, 2003; Berman, Bound, & Griliches, 1994). Years ago there were decent jobs for people without strong literacy, non-routine problem-solving, and complex communications skills, but today these jobs are diminishing (Autor et al., 2003; Berman et al., 1994; Bresnahan, Brynjolfsson, & Hitt, 2002; DePrince & Morris, 2008; Levy & Murnane, 1996). That is, the proportion of jobs requiring low-level skills decreased while the proportion requiring high level skills increased. The trend can also be observed in the widening income gaps between different levels of education. The income gap between high school dropouts and those with a high school degree was about $9,000 in 1964, but it was nearly doubled by 2005. The gap between high school graduates and people with a college degree was nearly $12,000 in 1964, but it was over $29,000 in 2005. And finally, there was not much of income difference between college graduates and those with an advanced degree in 1964, but the gap was approximately $12,000 in 2005 (Haskins, 2008).[1]

As technological advancements have made formal education a virtual prerequisite to financial security and economic success, high academic achievement has become an important factor in determining the life chances, occupational status, job stability, and wealth of individuals. Unfortunately, one of the major problems in the U.S. public education system is the achievement disparities between students of different backgrounds, such as ethnicities (Blair & Legazpi, 1999; Byrnes, 2003; Carpenter, Ramirez, & Severn, 2006; Kao & Tienda, 1998; Phillips, Brooks-Gunn, Duncan,

[1] Incomes are reported in 2004 U.S. dollars.

Klebanov & Crane, 1998; Shernoff & Schmidt, 2008), socioeconomic status (SES) (Blair & Legazpi, 1999; Byrnes, 2003; Carpenter et al., 2006; DeGarmo, Forgatch, & Martinez, 1999; Hativa, 1989; Phillips et al., 1998; White, 1982), levels of mathematics course taken (Cleary & Chen, 2009; Ma & McIntyre; 2005), parental education expectations (Goyette & Xie, 1999; Hill et al., 2004; Jacobs & Harvey, 2005; Mau, 1997), and peer groups (Crosnoe, Riegle-Crumb, Field, Frank, & Muller, 2008; Newgent, Lee, & Daniel, 2007; Mounts & Steinberg, 1995; Somers, Owens, & Piliawsky, 2007).

Since the No Child Left Behind Act (NCLB) was adopted in 2001, public schools and school districts are not only expected but required to improve the academic performance levels of groups of students who are poor, disabled, or from minority backgrounds in each school by 5% annually. Schools, especially low performing ones, are under tremendous pressure to meet adequate yearly progress (AYP) goals in order to avoid being labeled as a “failing school.” Therefore, assisting schools, policy makers, and concerned educators understand the important characteristics of “effective schools” and interventions that increase academic success for all students has become more important than ever before.

School Climate and Academic Achievement

To better understand school influence on student learning outcomes, theories about how to conceptualize human organizations can provide important theoretical perspectives. Just as people have distinctive personality characteristics, organizations also have their own characteristics (i.e. climates), that distinguish them from other organizations (Halpin & Croft, 1962). As schools are obviously organizations, school climate research has its roots in organizational psychology, and attempts to describe school characteristics have led to the proliferation of conceptualizations of school climate and specific school climate constructs that resemble organizational psychology constructs.

In an attempt to express the character of a human organization, Tagiuri (1968) developed a classic structure for defining an organizational climate. He defined organizational climate as “a relatively enduring quality of the internal environment of an organization that (a) is experienced by its members, (b) influences their behavior, and (c) can be described in terms of the values of a particular set of characteristics (or attributes)” (p. 27). Tagiuri’s taxonomy of organizational climate comprises four dimensions: *ecology*, the physical and material aspects of the environment; *milieu*, the persons and groups within the environment; *social system*, the patterns and rules governing operations and depicting the relationships among and between the persons and groups in the environment; and *culture*, the norms, values, and beliefs common in the environment.

School ecology and achievement. School ecology refers to the physical characteristics of the school that are external to the people in the school (Tagiuri, 1968). Indicators that can be used to measure school ecology in research include size, buildings and facilities, and materials and equipment (Anderson, 1982; Willms, 1992).

In the influential book *Savage inequalities: Children in America's Schools*, Kozol (1991) portrayed the difficulties for disadvantaged youth attending schools in poor neighborhoods or cities all over America and the disparities in school facilities, equipment, and resources that affect their aspirations, health, and achievement. A review of scientific literature provides further support for the influence of school environments on student learning—noise in the classroom can interfere with learning and schools with sufficient lighting improve academic performance and tests scores (Shendell, Barnett, & Boese, 2004). The use of computers in schools has also become more influential as technology advances. An intensive case study comparing high-poverty and low-performing schools to high-poverty but high-performing schools found that the latter are all high-technology ones, i.e., schools that are equipped with computers in classrooms and that have at least one computer laboratory (Sweet, Rasher, Abromitis, & Johnson, 2004).

School size also appears to have considerable effect on student achievement. Varied studies show that large schools have poor academic performance (Benner, Graham, & Mistry, 2008; Darling-Hammond, Ancess, & Ort, 2002; Lee & Smith, 1995, 1997, 1999) and higher dropout rates (Darling-Hammond et al., 2002; Lee & Burkam, 2003) than their mid or small-size counterparts. Research on the mechanisms through which size translates into effects on students reveals that the larger schools offer a broader curriculum (i.e. larger amount as well as variety of courses) but only the most able students or parents have sufficient knowledge to navigate wisely the wide array of courses (Lee, Smerdon, Alfeld-Liro, & Brown, 2000). Meanwhile, students and teachers in smaller schools report higher levels of social and academic support (Lee & Burkam, 2003; Lee et al., 2000; Lee & Smith, 1995, 1999). Such findings suggest that students may benefit from social advantages that accompany smaller size.

School milieu and achievement. School milieu refers to the characteristics of the people in the school (Tagiuri, 1968). Manifestation of milieu includes student population characteristics (e.g., ethnic composition, family backgrounds, achievement) and teacher characteristics (e.g., credential, education, experience) (Anderson, 1982; Willms, 1992).

Evidence reveals that youths attending schools with high concentrations of ethnic minority, low family income, and poor achieving students tend to have poorer achievement (Benner et al., 2008; Konstantopoulos, 2006; Lee & Bryk, 1989; Powers, 2003) and lower graduation rates (Balfanz & Legters, 2004; Bryk & Driscoll, 1988; McNeal, 1997; Swanson, 2004). This is especially salient for African American and Latino/a students. Because they are more likely to grow up in disadvantaged neighborhoods and attend disadvantaged schools, their educational attainment may be further limited by their exposure to such learning environments (Balfanz & Legters, 2004; Benner et al., 2008; Myer & Jencks, 1989). There are different plausible explanations for this phenomenon. Some believe that when a student is placed in a group of disadvantaged youths, the group may inhibit the student's effort and aspirations to success (Benner et al., 2008; McNeal, 1997; Fordham & Ogbu, 1986). Others argue that schools are just reflections of the surrounding communities and it is the disadvantaged neighbors impeding educational outcomes (Myer & Jencks, 1989).

Teacher characteristics are also critical components of school milieu. A variety of studies report that teaching experience (Clotfelter, Ladd, & Vigdor, 2006; Goldhaber & Brewer, 1997; Powers, 2003; Rivkin, Hanushek, & Kain, 2005; Rockoff, 2004), level of education (Goldhaber & Brewer, 1997; Powers, 2003), and credentials (Durán-Narucki, 2008; Goldhaber & Brewer, 1997; Powers, 2003) are positively correlated to achievement. There are huge differences in the qualifications of teachers across schools, and the differences are associated with average student SES. Compared to suburban schools, urban schools that serve predominantly low family income, low achieving, and ethnic minority students tend to have less skilled teachers (Lankford, Loeb, & Wyckoff, 2002). Research also show that school counseling programs with an aim at identifying and eliminating systemic barriers that impede student academic success lead to better performance (Bruce, Getch, & Ziomek-Daigle, 2009; Luck & Webb, 2009; Sink & Stroh, 2003; Wyatt, 2009).

School social system and achievement. School social system represents the formal and informal patterns of operation, as well as the relations among and between the people and groups (Tagiuri, 1968).

Variables or constructs representing school operation patterns may include administrative organization, ability grouping, and shared decision making (Anderson, 1982; Willms, 1992). Rigorous studies in this area are rare and findings are often conflicting and controversial. Take ability grouping (sometimes called "tracking") as an example. A few studies show ability grouping has some positive effect on students of different achievement levels (e.g. Mulkey, Catsambis, Steelman, & Crain, 2005), but others imply that the practice increases educational disparities (Gamoran & Mare, 1989; Holcomb-McCoy, 2007). Or take the popular idea that teacher and student participation in school decision making improves student learning. This common view has no empirical support (Elenbogen & Hiestand, 1989; Leech & Fulton, 2008).

On the other hand, a relatively large body of research has demonstrated the relationship between student learning outcomes and social/relational factors within schools. Findings reveal that positive social and academic support from teachers, counselors, and administrators is beneficial to students' achievement (Benner et al., 2008; Brand et al., 2003; Brand et al., 2008; Fenzel & O'Brennan, 2007; Lee & Smith, 1999; Malecki & Demaray, 2006) and their educational attainment (Bridgeland, Dilulio, &

Morrison, 2006; Cooper & Liou, 2007; King, 1996; Knight, 2003). Even students of ethnic minorities or with low-SES backgrounds are more likely fulfill their academic potential and to persist in the education system in schools with greater teacher-student rapport (Cooper & Liou, 2007; Knight, 2003; Malecki & Demaray, 2006).

The relationship and civility among student groups also have the potential to influence student academic achievement. Several studies show that students perform better in schools with civility and orderly leaning environments (Brand et al., 2003; Brand et al., 2008; Fenzel & O'Brennan, 2007; Stone & Han, 2004). Noteworthily, G. D. Gottfredson and Gottfredson (1985) indicated that schools in which students perceive greater fairness and clarity of rules have less delinquent behavior and less student victimization.

School culture and achievement. School culture reflects the norms, values, and beliefs that characterize the school, the people within the school, and the interactions among the people in the school (Tagiuri, 1968). Culture indicators may include expectations for academic success, rewards and praise, disciplinary standard, and quality of school life (Anderson, 1982; Willms, 1992).

A normative emphasis on academic excellence and conformity to high academic standards is identified as "academic press" (Murphy et al., 1982). Research does show that such achievement-oriented emphasis creates a school climate in which both teachers and students are more likely to persist in their academic efforts and succeed (Goddard, Sweetland, & Hoy, 2000; Hoy, Sweetland, & Smith, 2002; Hoy, Tarter, & Hoy, 2006; Lee & Loeb, 2000; Lee & Smith, 1999; Philips, 1997). Philips (1997) even suggested that such an academic climate is more important for student academic success than are positive social relationships between teachers and students.

Purpose of the Study

The purpose of this study is to examine the degree of association between the response variable of academic achievement and the predictor variables of school ecology, milieu, social system, and culture. This study can be significant to educational policymakers, and concerned educators and researchers for various reasons. The findings can assist educational policymakers in developing proposals that advocate for more effective practices and school reforms. For instance, the small school movement is one of the most popular reform strategies and the results of the study may provide further evidence of whether or not school size matters to academic achievement at the high school level. Education practitioners and professional school counselors can use the findings to develop effective school climates, pursuing programs and interventions that will increase the academic success of all students. The study can also add knowledge about the influence of school climate on achievement. Despite compelling empirical studies show that a solid relationship between school characteristics and academic performance, the major concern is that most research focused on one or a few school-level variables only. This study stands out from the rest by using a more inclusive framework (i.e. Tagiuri's taxonomy) to conceptualize school climate and, meanwhile, controlling for several important individual-level characteristics.

Research Questions and Design

The overall question that this study addresses is "can the academic achievement of public high school students be explained by variables representation of categories in Tagiuri's (1968) taxonomy of school climate?" The study focused specifically on mathematics achievement for the following reasons. First, more than half of the U.S. states adopt minimum graduation requirements for mathematics (Zinth, 2006). Second, mathematics is an important gateway to postsecondary education and one of the best predictors of college succuess (Adelman, 1999; Cabrera, Burkum, & La Nasa, 2005; Sadler & Tai, 2007; Simpkins, Davis-Kean, & Eccles, 2006). Moreover, employment and education data indicate that knowledge and skills in mathematics are thresholds for high-paying jobs (Carnevale & Desrochers, 2003).

To achieve the objective of the study, specific research questions were formulated to guide the selection of data useful for determining the strength of the relationship between mathematics achievement and the school ecology, milieu, social system, and culture. Specifically, the study sought to answer the following questions:

1. Are variables representing school ecology, milieu, social system, and culture significantly associated with public high school students' mathematics achievement?
   - 1a. Are the individual characteristics of public high school students significantly associated with mathematics achievement?
   - 1b. Are variables representing school ecology, milieu, social system, and culture significantly associated with mathematics achievement of public high school students beyond the variance accounted for by their individual characteristics?

The research approach for the present study is a quantitative analysis using multilevel regression modeling. Data were drawn from the Education Longitudinal Study of 2002 (ELS:2002) restricted-use dataset, which offers the opportunity to conduct longitudinal studies on a nationally representative sample of American high-school-age youth, and a series of multilevel regression analyses was conducted to answer the research questions. The major disadvantage is the limitations of information that was collected in the dataset. The correlational nature of the study also posed limits to infer causality.

Summary

In the current educational system, youths from low-income families and ethnic minority backgrounds are less likely to achieve academically than their more affluent and White and Asian counterparts. In an era when formal education has become an important factor in determining life chances, occupational status, job stability, and wealth of individuals, people with little education are more likely to end up being stuck with entry-level, low-wage jobs or experiencing unemployment and remain at the bottom of the social hierarchy. This study attempted to draw on Tagiuri's (1968) taxonomy of school climate to examine the influence of school ecology, milieu, social system, and culture upon public high school students' academic performance. Chapter 1 has discussed the school ecology, milieu, social system, and culture variables that have been observed to affect learning. This chapter also presented the purpose and importance of the study, as well as the research questions and design. The following chapter presents a review of the literature that includes the theoretical framework for the proposed study and results from previous studies. All of these topics serve as a foundation for chapter 3 on method.

Chapter 2

Literature Review

Theory and Conceptualization of School Climate

The concern for school climate and its effect on student academic and behavioral performance can be dated to the beginning of the 20th century. In 1908, Perry underlined the importance of school environment in learning that students "are distinctively influenced by their surroundings, and that it becomes a duty of the school to provide something more than mere 'housing'" (p. 303). Perry called the school environment *esprit de corps*, suggesting an atmosphere that is embedded in the school and is developed by the involvement of the principal, teachers, students, parents, and alumni. Since then, compelling empirical studies show that a positive school climate can promote academic achievement and healthy development (further and detailed discussions can be found on pages 16-25 in this chapter).

It may not be an issue for education practitioners and researchers to accept the importance and influence of school climate. The major concerns are: what to look at in schools regarding climate, and how to look at it (Anderson, 1982; Freiberg & Stein, 1999; Tagiuri, 1968).

Theories about how to conceptualize human organizations can provide important theoretical perspectives in understanding school climate. Human organizations are not organic beings in the biological sense, but just as people display individual differences in their characteristics, organizations also have their own characteristic "personalities," i.e. climates, that distinguish them from others (Halpin & Croft, 1962). As schools are obviously organizations, school climate research has its roots in organizational climate study and attempts to describe these school characteristics have led to the proliferation of conceptualizations of school climate and specific school climate constructs.

In an attempt to express theoretically meaningful and operationally useful concepts that refer to variations between human organizations, Tagiuri (1968) reviewed theories and studies on environment and climate, and then defined organizational climate as "a relatively enduring quality of the internal environment of an organization that (a) is experienced by its members, (b) influences their behavior, and (c) can be described in terms of the values of a particular set of characteristics (or attributes)" (p. 27). That is, climate includes the objective and subjective environmental quality within a given organization, and influences the attitudes and expectancies of what is rewarded and punished in an organization, thus affecting attitudes and behavior of the people in the organization. Tagiuri further proposed a four-category taxonomy of organizational climate: *ecology*, the physical and material aspects of the environment; *milieu*, the persons and groups within the environment; *social system*, the patterned relationships of the persons and groups in the environment; and *culture*, the norms, values, and beliefs common in the environment. He wrote, "[a] particular configuration of enduring characteristics of the ecology, milieu, social system, and culture constitute a climate, much as a particular configuration of personal characteristics constitute a personality" (p. 23). More detailed discussions about school-level indicators representing the four dimensions and their effects upon student academic performance can be found on pages 16-25 in this chapter.

Besides Tagiuri's work, a voluminous amount of material has also been written on conceptualizing and categorizing the climate of schools. The following paragraphs provide examples.

Examining the between-school variations in the educational and social environments of a small sample of high schools, McDill, Rigsby, and Meyers (1969) identified six factors comprising school climate: *academic emulation*, an atmosphere of academic excellence; *student perception of intellectualism-estheticism*, student-perceived pressures for academic excellence and relationships between students and school staff; *cohesive and egalitarian estheticism*, the social system of the schools emphasize intellectual criteria for status and the social integration among students; *scientism*, having a scientific emphasis; *humanistic excellence*, faculty pressures toward creating and maintaining student interest in social sciences and in topics of social concern; and *academically oriented student status system*, an atmosphere of academic excellence among student peer groups.

In order to conceptualize environmental variables and systemically examine their association with behavior, Moos (1973) proposed a six-category theoretical approach comprising *ecological dimensions*, the geographical-meteorological and architectural-physical design of an organization; *behavior settings*, the ecological and behavioral properties that have considerable importance in the determination of individual behavior and experience; *organizational structure*, the positions and parts of an organization and their systematic and enduring relationships to each other; *personal and behavioral characteristics of the inhabitants*, the characteristics of the individuals inhabiting an organization; *psychosocial characteristics and organizational climate*, the relationship, personal development, system maintenance, and system change dimensions of an organization; and *functional or reinforcement properties of environments*, the controlling stimulus conditions for certain behaviors. Moos sated that "[t]he six categories of dimensions are nonexclusive, overlapping, and mutually interrelated" (p. 652). , Moos (1979) later proposed a revised four-category system consisting of ***physical setting***, architecture and physical design that influence psychological states and social behavior; *organizational factors*, the positions and parts of an organization and their systematic and enduring relationships to each other; *human aggregate*, the characteristics of the individuals inhabiting an organization; and *social climate*, the environmental press of certain behaviors. He then developed a set of nine social climate scales (for an overview, see Moos, 1994).

Focusing on how the organization sets a normative environment that motivates its members to behave in desirable ways, Murphy, Weil, Hallinger, and Mitman (1982) defined academic press as "the degree to which school forces press for student achievement on a school-wide basis" (p.22). They proposed a framework for conceptualizing the academic environment that presses students to achieve, which comprises school policies, practices, expectations, norms, and rewards for student learning that are generated by both school staff and students. They also argued that the importance of school policies and classroom practices that promote academic press.

Hoy and Tarter (1987) used a health metaphor to examine the general well-being of the interpersonal relation in the school. They stated that "a healthy school is one in which the teachers, administrators, and the board are in harmony, and the school meets both its organizational and people needs as it pursues its missions" (Hoy & Tarter, 1992, p. 75). To further conceptualize school health, they propose a three-level seven-dimension framework. At the board level, *institutional integrity* refers to the ability of a school to protect its academic integrity from outside forces. At the administrative level, *initiating structure* is the principle leadership behavior targeting at achievement; *consideration* indicates the principle leadership behavior with an aim at harmonious interpersonal relationships; *resource support* refers to principle managerial behavior that ensures necessary school supplies; and *principal influence* is the ability of the principle to influence superiors. At the teacher level, *morale* refers to a sense of community among teachers, and *academic emphasis* indicates the extent to which a school presses students to achieve. Later in 1991, Hoy, Tarter, and Kottkamp developed the Organization Health Inventory for teachers based on their conceptual framework.

To investigate the structural and compositional features of schools relate to a communal organization, Bryk and Driscoll (1988) suggested three core components comprising the construct of a school, which include *shared value system*, the culture and norms for instruction and civility; *a common agenda of activities*, the shared activities and rituals that link students and teachers to each other and to the traditions and values of a school; and *formal organizational characteristics*, the collegial interactions among the adults in a school and the academic and nonacademic responsibilities of teachers.

Regarding the assessment of secondary school climates, Gottfredson (1984) developed the Effective School Battery (ESB). The initial ESB student inventory comprised 12 parts: Parental Education, Positive Peer Associations, Educational Expectation, Social Integration, Attachment to School, Belief in Rules, Interpersonal Competency, Involvement, Positive Self-Concept, School Effort, Avoidance of Punishment, and School Rewards. The ESB teacher inventory consists of seven parts: Pro-Integration Attitude, Job Satisfaction, Interaction with Students, Personal Security, Classroom Orderliness, Professional Development, and Nonauthoritarian Attitude. After investigating the underlying constructs of the items in the student inventory, a revision was published in 1999 (Gottfredson, 1999). The revised ESB student inventory has four sets of measures: *social background*, the family and educational backgrounds of the students; *peer relations*, the relationships and associations among students; *attitudes and psychosocial development*, student attitudes toward education, academic effort, convention rules, their schools, and themselves; and *school experiences*, the punishments and rewards that students encountered in school.

Focusing on student perception of school social climate, Brand and colleagues (2003) developed the Inventory of School Climate-Student (ISC-S) after several phases of item and factor analysis. The ISC-S contains 11 subscales: Teacher Support, Consistency and Clarity of Rules and Expectations, Student Commitment/Achievement Orientation, Negative Peer Interactions, Positive Peer Interactions, Disciplinary Harshness, Student Input in Decision Making, Instructional Innovation/Relevance, Support for Cultural Pluralism, and Safety Problems.

Table 1 summarizes the comparisons of school climate concepts between the above delineations and Tagiuri's (1968) taxonomy. Conceptually, most of the dimensions or measures can be sorted into the categories of school milieu, social system, and culture. The physical and material aspect of a school is rarely mentioned when conceptualizing or measuring school climate, except for Tagiuri and Moos (1979). Some of the measures or scales encounter the individual differences fallacy—an error in units of analysis that involves interpreting results based on individuals as though the results apply to the environments (Richards, 1990; Richards, Gottfredson, & Gottfredson, 1991). Moos' scales, for instance, assess the individual differences within rather than between schools (Richards, 1978) so that technically, his measures should only be treated as human aggregates, i.e. milieu. In sum, Tagiuri's taxonomy seems to be an appropriate and relatively inclusive framework to conceptualize school climate.

Tagiuri's Taxonomy of School Climate and Academic Achievement

Tagiuri (1968) proposed a four-dimension taxonomy of organizational climate: ecology, milieu, social system, and culture. The following discusses the school-level indicators representing the four dimensions and their effects upon student academic performance.

School ecology and achievement. School ecology refers to the physical characteristics of the school that are external to the people in the school (Tagiuiri, 1968). Even though school climate instruments tend to ignore the dimensions of ecology (see Table 1), concepts that had been measured and used in research representing school ecology include buildings and facilities, materials and equipment, and available special services (Anderson, 1982; Willms, 1992).

Schools ought to be planned, designed, built, renovated, and maintained at high standards to provide an environment for learning (American Federation of Teachers, 2006; Healthy Schools Network, 2004), but that is not the case for all schools. In the influential book *Savage Inequalities: Children in America's Schools*, Kozol (1991) portrayed the difficulties for disadvantaged youth attending schools in poor neighborhoods or cities all over America and the disparities in school facilities, equipment, and resources that negatively affect their aspirations, health, and achievement. A public high school in New York City, for example, where "[t]wo thirds of the stained-glass panes are missing and replaced by Plexiglas. Chunks of wall and sections of the arches and supporting pillars have been blasted out by rot. Lights are falling from the ceiling" (Kozol, 1991, p. 106) and a school like this tends to be the "most crowded and have the highest drop out rates and lowest scores" (Kozol, 1991, p. 107).

Two reviews of scientific literature provide some further support for the influence of school physical environments on student learning. Mendel and Heath (2004) suggested that humidified buildings (i.e., dampness, water-damage, mold damage) increase the prevalence of eye irritation and respiratory infections, which may lead to higher absenteeism rates and, then, poorer academic performance. The reported correlation, however, may not be causal because the studies that Mendel and Heath reviewed did not test the direct link between school physical environment and achievement. In a similar but more comprehensive review, Shendell and colleagues (2004) identified a strong connection between school environmental quality and health. Moreover, they found two studies indicating that noise in the classroom does interfere with learning and improved lighting does increase student academic performance and tests scores.

As technology advances, the use of computers in schools has also become more influential. It helps not only to analyze data, but to improve curriculum, instruction, evaluation, and communication (Perera, 2008; Sutherland, 2004). An intensive case study comparing high-poverty and low-performing schools to high-poverty but high-performing schools found that the latter are all high-technology ones, i.e., schools that are equipped with computers in classrooms and that have at least one computer laboratory (Sweet, Rasher, Abromitis, & Johnson, 2004). There is also a digital gap between high and low SES schools. After analyzing data collected by the Florida

Department of Education, Hohlfeld and colleagues (2008) found significant differences in the accessibility to technology and technological support within K-12 schools, which suggest that students in the more economically advantaged schools may be better prepared for technological advancement.

Size is an important ecological feature of a school and appears to have considerable influence on student academic performance. Conant (1959), the acknowledged father of the comprehensive high school, declared that high school enrollments have to exceed 1,000 students per school in order to sufficiently implement his recommended curriculum. Varied studies, however, show that low student achievement (Benner et al., 2008; Darling-Hammond et al., 2002; Lee & Smith, 1995, 1997, 1999) and high dropout rates (Darling-Hammond et al., 2002; Lee & Burkam, 2003) can be traced to large schools, especially high schools. Students from educationally and economically disadvantaged backgrounds especially appear to benefit from smaller school size (Darling-Hammond et al., 2002; Leithwood & Jantzi, 2009). Doubts about the ability of large high schools to promote the achievement of their students have made the small school movement one of the most popular reform strategies. The Carnegie Foundation, for instance, claimed that high "schools must break into units of no more than 600 students so that teachers and students can get to know each other" (National Association of Secondary School Principals, 1996, p. 5).

Despite widespread agreement on the negative influence of large schools in educational research, there is no agreement about the mechanism that directly links size and student academic performance. Lee and colleagues (2000) studied the mechanisms through which size translates into effects on students and suggested that larger schools tend to offer a broader curriculum (i.e. larger amount as well as variety of courses) but only the most able students or parents have sufficient knowledge to navigate wisely the wide array of courses. Lee and her other colleagues (Lee & Burkam, 2003; Lee et al., 2000; Lee & Smith, 1995, 1999) further argued that size operates as an ecological feature of the social structure that students and teachers of smaller schools experience higher levels of social and academic support. Such findings imply that students may benefit from social advantages that accompany smaller size.

School milieu and achievement. School milieu refers to the characteristics of the people in the schools (Tagiuiri, 1968). School milieu may include student population characteristics (e.g., ethnic composition, family backgrounds, achievement) and teacher characteristics (e.g., credentials, education, experience) (Anderson, 1982; Willms, 1992).

Considering the high correlations among ethnicity, income, class, neighborhood, and student learning outcomes in the United States, it is not surprising to find a solid relationship between academic performance and the aggregated characteristics of students. Schools with higher proportions of ethnic minority (e.g., Latino/a or African American), low family income, and poor achieving students generally have poorer average achievement (Benner et al., 2008; Konstantopoulos, 2006; Lee & Bryk, 1989; Powers, 2003) and lower graduation rates (Balfanz & Legters, 2004; Bryk & Driscoll, 1988; McNeal, 1997; Swanson, 2004) than other schools.

The mechanisms through which student composition translates into effects on achievement are complex. Fordham and Ogbu (1986) argued that youth of certain ethnic minority groups consider academic success as *acting White* and may devalue scholastic achievement. When a student is placed in a school with high concentrations of such ethnic minorities, the student's effort and aspirations to learning may be inhibited by the peer group (Benner et al., 2008; McNeal, 1997). Others have argued that schools are merely reflections of the surrounding communities and it is the disadvantaged neighbors, not the schools, impeding educational achievement (Myer & Jencks, 1989). Take the second-generation West Indian Black students who grew up in New York City for instance. The first-generation West Indian Black immigrants had good reputations as skilled and diligent workers and were able to excel, but "the ambition that propelled Caribbean parents to immigrate to America is rapidly quashed in second-generation children by the repressive forces of daily life in the American ghetto" (JBHE Foundation, 1996, p. 47). The author called the phenomenon *surrender to the force of the ghetto.* Especially when African American and Latino/a students are more likely to grow up in disadvantaged neighborhoods and attend disadvantaged schools, their educational attainments are further limited and reduced by their exposure to such living and learning environments (Balfanz & Legters, 2004; Benner et al., 2008; Myer & Jencks, 1989).

Few would deny that teachers are also critical components of schools. Early studies, however, suggested that teacher characteristics are relatively unimportant predictors of achievement, especially when taking student individual characteristics and family backgrounds into consideration (Hanushek, 1986). Goldhaber and Brewer (1997) argued that these studies had major deficiencies in research methodology and statistical analysis. With the improvement of research design and the availability of multilevel data and analysis, there is evidence that credentials (Durán-Narucki, 2008; Goldhaber & Brewer, 1997; Powers, 2003), level of education (Goldhaber & Brewer, 1997; Powers, 2003), and teaching experience (Clotfelter, Ladd, & Vigdor, 2006; Goldhaber & Brewer, 1997; Powers, 2003; Rivkin, Hanushek, & Kain, 2005; Rockoff, 2004) have positive effects upon student academic performance. The major concern is that most research cited above, except for the work done by Powers and Durán-Narucki, examined the effect only at the individual level, so that the findings may not be applicable to school-level measures. Most importantly, there may be differences in the qualifications of teachers across schools, and the differences are associated with average student SES. Compared to suburban schools, urban schools that serve predominantly low family income, low achieving, and ethnic minority students tend to have the least skilled teachers (Lankford, Loeb, & Wyckoff, 2002).

Professional school counselors may also play an important role in student learning. As clearly stated in the American School Counselor Association (ASCA) National Model (ASCA, 2005), school counselors ought to develop district and school-based school counseling programs that are aligned with the district and school-wide goals—academic achievement for all students. Several small scale studies revealed that counseling programs that target academic issues not only improve students' pass rates in high-stakes testing (Bruce et al., 2009; Luck & Webb, 2009; Wyatt, 2009), but also narrow the Black-White achievement gap (Bruce et al., 2009). In a large sample study, Sink and Stroh (2003) examined data from 150 Washington state public elementary schools and concluded that well-established comprehensive school counseling programs can significantly decrease educational disparities among students over a two to three year time period.

School social system and achievement. School social system represents the formal and informal patterns of operation, as well as the relations among and between the people and groups (Tagiuri, 1968).

Variables or constructs representing school operation patterns may include administrative organization, ability grouping, and shared decision making (Anderson, 1982; Willms, 1992). The major concerns are that empirical research into the possible consequences of school operation patterns is rare and findings are often conflicting and controversial. Teacher participation in shared decision making, for instance, has aroused educators and policymakers' interest over the recent years (Keedy & Finch, 1994; Morrison, Wakefield, Walker, & Solberg, 1994). Some studies cite the positive effect of the implementation of participatory decision making on teacher communication and morale (Elenbogen & Hiestand, 1989; Johnson & Pajares, 1996; Leech & Fulton, 2008; Sebring & Camburn, 1992), but some reveal that it results in heavier workload and more conflicts (Weiss, 1991; Welsh, 1987). Even though Ashton and Webb (1986) argued that participatory decision making would improve teachers' sense of empowerment, teaching quality and student achievement, no expected positive influence on student outcomes was revealed (Elenbogen & Hiestand, 1989; Leech & Fulton, 2008). On the other hand, Feuer and Mayer (2009) advocated for students' voice in school decision making, but no rigorous study was found regarding its influence.

Ability grouping (sometimes called "tracking") is another example. Supporters believe ability grouping is a workable approach to instructing students with different skill levels (Mulkey, Catsambis, Steelman, & Crain, 2005; Shanker, 1993). Mulkey, and colleagues (2005) compared the mathematical progress of students in tracked and untracked schools and found that tracking has persistent instructional benefits for all students. However, evidence also reveals varied, inconsistent effects of ability grouping on achievement. Abadzi (1984) suggested that the practice only shows significant influence on those near the cutoff score for placement in high and regular ability groups but has no effect on highest and lowest achieving students. In another study, Gamoran and Mare (1989) revealed that in high school, the achievement gap widens between students in academic programs and those in nonacademic programs. The results lead opponents to the conclusion that ability grouping only raises achievement for students in high-level classes but depresses learning for those of lower achievement levels. Brookover and colleagues (1997) cliamed that ability grouping "creates conditions for academic and social failure rather than mastery; it heightens tensions between groups, usually along racial and social class lines; and it undermines good citizenship by fostering feelings of injustice and resentment among those denied equal educational opportunity" (p. 281).

In contrast, a relatively large body of research has demonstrated the relationship between student learning outcomes and social/relational factors within schools. Just as a supportive counselor-client working relationship promotes better therapeutic outcomes, positive social and academic support from teachers, school counselors, and administrators is beneficial to students' achievement (Benner et al, 2008; Brand et al., 2003; Brand et al., 2008; Fenzel & O'Brennan, 2007; Lee & Smith, 1999; Malecki & Demaray, 2006; Stone & Han, 2004) and their educational attainment (Bridgeland et al., 2006; Cooper & Liou, 2007; King, 1996; Knight, 2003). Studies on the mechanism through which teacher-student relationship translates into effects on achievement suggest that a positive relationship can help students to develop higher educational engagement (Benner et al., 2008) and aspirations (Hardré & Sullivan, 2008; Plucker, 1998). Even students of ethnic minorities or with low-SES backgrounds are more likely to fulfill their academic potential and to persist in the education system in schools with greater teacher-student rapport (Cooper & Liou, 2007; Knight, 2003; Malecki & Demaray, 2006). More than half of the studies cited above, however, analyzed their data only at the individual level so that the findings may not be applicable to school-level characteristics, i.e. school social system.

The relationship and civility among student groups also have the potential to affect student academic achievement. Several studies show that students perform better in schools with civility and orderly leaning environments (Brand et al., 2003; Brand et al., 2008; Fenzel & O'Brennan, 2007; Stone & Han, 2004). Sequentially examining the effect of school climate rated by students and teachers, Brand and colleagues (2003, 2008) suggested that school safety and student disruptive behavior are important predictors of the average student achievement. Fenzel and O'Brennan, (2007) focused only on African American youths and reached a similar conclusion that urban Black students are more engaged in academic work if they perceive the school social environment as enjoyable. Stone and Han (2004) also came to a similar conclusion that Mexican immigrant youth have higher grades in schools with less tension and discrimination among students. Noteworthily, student civility may have something to do with a fair school policy. Gottfredson and colleagues (1985, 2005) found that schools in which students perceive greater fairness and clarity of rules have less delinquent behavior and less student victimization.

School culture and achievement. School culture reflects the norms, values, and beliefs that characterize the school, the people within the school, and the interactions among the people in the school (Tagiuiri, 1968). It includes norms about how things should be done, norms and values about what is acceptable or not acceptable, and rewards and punishments for behaviors that are valued or not accepted in the school (Anderson, 1982; Willms, 1992).

In terms of achievement, a normative emphasis on academic excellence and conformity to high academic standards is identified as *academic press* (Murphy et al., 1982). Murphy and colleagues (1982) defined academic press as “the degree to which environment forces press for student achievement on a schoolwide basis….[I]t pulls together various forces—school policies, practices, expectations, norms, and rewards—generated by both staff and students” (p. 22). Evidence supports that such achievement-oriented emphasis creates a school climate in which both teachers and students are more likely to persist in their academic efforts and succeed (Goddard et al., 2000; Hoy et al., 2002; Hoy et al., 2006; Lee & Loeb, 2000; Lee & Smith, 1999; Philips, 1997). Specifically, in schools where most teachers are highly committed to achievement for all students, the normative and behavioral environment will pressure teachers to persist in their educational efforts to have students succeed; meanwhile, teachers may be sanctioned if they behave in ways that conflict with the shared beliefs of the school. Philips (1997) even suggested that such an academic climate is more important for student academic success than are positive social relationships between teachers and students.

Summary

As technology advances, high academic achievement (particularly math achievement) has become a powerful vehicle for social access and social mobility.

Youths who do not achieve in mathematics are less likely to go to college and obtain a degree. Hence, they are more likely to acquire entry-level, low-wage jobs, experience unemployment, or remain at lower income levels. Unfortunately, there exist achievement disparities between students of different backgrounds. The literature suggests that school climate is a significant predictor of student achievement. As a result, assisting schools, policy makers, and concerned educators in identifying the components of effective school climates, and developing programs and interventions with an aim at academic success for all students have become more important than ever. Chapter 2 discussed the literature and research regarding conceptualizations of school climate, the school-level indicators representing the four dimensions of school climate (i.e., ecology, milieu, social system, and culture), and the association between school climate variables and achievement. The following chapter introduce the dataset, sample, variables, and analytical procedure of the present study.

Chapter 3

Method

The purpose of this study is to understand the influence of school climate upon academic performance. Specifically, a non-experimental quantitative research design using data from the Education Longitudinal Study of 2002 (ELS:2002) retricted-use dataset is utilized to examine the degree of association between the response variable of 12th-grade mathematics achievement in public high schools and the predictor variables representing Tagiuri's (1968) four dimensions of school climate, i.e., ecology, milieu, social system, and culture. The research questions are:

1. Are variables representing school ecology, milieu, social system, and culture significantly associated with public high school students' mathematics achievement?

    1a. Are the individual characteristics of public high school students significantly associated with mathematics achievement?

    1b. Are variables representing school ecology, milieu, social system, and culture significantly associated with mathematics achievement of public high school students beyond the variance accounted for by their individual characteristics?

ELS Data and the Analytical Sample

Collected by the U.S. Department of Education's National Center for Educational Statistics (NCES), the ELS:2002 public-use data are designed to monitor the transition of a nationally representative sample of American youths as they progress from 10th grade through high school. The longitudinal nature of ELS:2002 design offers the opportunity to conduct longitudinal studies at small cost. In addition, ELS:2002 gathered information not only from students, but also from students' parents, teachers, administrators, and librarians of their schools. This multilevel focus supplies researchers with a comprehensive picture of the home, community, and school environments and their influences on the student.

In 2002, the base year, 752 schools were randomly selected from about 25,000 public and private high schools across the United States. Over 15,000 10th-graders were then randomly selected from those 752 schools, with Asian and Latino/a American students being over sampled to ensure a sufficient number of cases, to represent approximately 3 million students who attended 10th grade in the United States in that year. In spring term 2002, the sample students were surveyed about their backgrounds, attitudes, and experiences, and were given tests in reading and mathematics. Their parents, mathematics and English teachers, administrators, and librarians were surveyed, and information regarding school facilities were collected as well.

The basis for the sampling for the first follow-up is the base-year sample of schools and students. In 2004, the bulk of the ELS:2002 sophomore cohort who remained in their base-year schools were resurveyed and tested in mathematics. For those who transferred to a new school, a transfer student questionnaire was utilized and the test score in mathematics was imputed. Those who dropped out of high school, graduated early, or went to a home-schooling setting were given different sets of questionnaires. An additional small sample of students (n=202), who were enrolled in the 12th grade in the spring of 2004 at the base-year sample schools but were not selected in the base-year sample, were also given the first follow-up survey and the mathematics achievement test.

In an attempt to examine the influence of school ecology, milieu, social system, and culture upon public high school students' academic performance, the target students for the proposed study are those students who took the base-year survey and reported the base-year and first follow-up mathematics achievement test scores. Students without an assigned weight, without base-year data, without base-year and first follow-up achievement tests scores, and from Catholic and private schools were omitted. Schools with less than four valid student respondents were dropped from the analysis in order to obtain reliable estimates of school climate. The resulting sample for this study consists of 7,279 students from 416 public high schools (see Table 2 and Table 3). The average number of students per school is 17.50, with a SD of 5.48 and a range from 4 to 35.

Measurements

Table 5 displays a list of original ELS:2002 and recoded/transformed variables used in the analysis.

Design weights. To better represent the general population, ELS:2002 comes with weights to compensate for the effect of unequal sampling, attrition, and nonresponse. The individual-level first follow-up panel weight F1PNLWT was created to compare base-year data with first follow-up data for those who were respondents in both. The school-level weight BYSCHWT allowed representation of American high schools in 2002. In the multilevel analyses, the level-1 weight was estimated by dividing the first follow-up panel weight F1PNLWT by the school weight BYSCHWT,[2] and the level-2 weight is the school weight BYSCHWT.

Response variable. The response variable is 12th-grade mathematics

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[2] The ELS:2002 student-level weight "accounts for the base-year school probability of selection (adjusted for nonresponse) and for the base-year student probability of selection within the sample school" (Ingels et al., 2005, p. 61).

achievement, ZF1STDM, represented by the standardized (i.e. *z*-score transformation) 12th-grade mathematics scores in 2004 based on Item Response Theory (IRT).[3] The original variable F1TXM1IR documents the mathematics IRT estimated number right score at 12th-grade in 2004. The ZF1STDM is the *z*-score transformation of F1TXM1IR, with a mean of 0, a SD of 1, and a range from -2.15 to 2.29. The intraclass correlation coefficient (ICC) and lambda-hat coefficients are shown in Table 5. An ICC of .16 means that more than one-sixth of the variance in the 2004 mathematics achievement was accounted for by between-school differences. A lambda-hat of .74 indicates that the school mean is a reliable estimate. In addition, the statistics suggests that on average, sampled students scored higher than those who were dropped from the analysis, mean difference = 0.16, t = 6.77, p < .001 (see Table 6).

Predictor variables. In an effort to explain the influence of school climate upon educational achievement using Tagiuri's (1968) taxonomy, variables representing school ecology, milieu, social system, and culture (see Table 5) are included in the analyses.

School ecology variables.

School size indicates the total student enrollment in the 2001-2002 school year. The variable CP02STEN documents the number of students enrolled in each school based on information from the NCES Common Core of Data (CCD) 2001-2002. Because the distribution is skewed to the left, it was converted into four dummy variables, based on Lee and her colleagues' works (Lee & Smith, 1997; Lee & Burkam, 2003), with the following school size groupings: SMALL, 599 students or less; MEDIUM, 600-1,599 students; LARGE, 1,600-2,499 students; and V_LARGE, more than 2,500 students. In

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[3] The IRT score uses patterns of correct, incorrect, and omitted answers to obtain estimates that are comparable across different test forms within a domain. The process also accounts for each test question's difficulty, discriminating ability, and a guessing factor.

the analytical sample, 19% are small schools; 42% are medium-size ones; 32% are large; and 8% are very large schools (see Table 7). In addition, the statistics shows that comparing to schools with missing data, the sampled school are more likely to be small and medium ones and less likely to be very large schools.

Insufficient lighting represents the presence of broken lights in the classrooms. Listed in the 2002 school facilities checklist, the dichotomous variable BYF05C documents whether broken lights were observed in classrooms in which students are taught. In the analytical sample, only 2% of the schools have broken lights in the classrooms (see Table 7). Further, the statistics suggests there is no significant difference regarding insufficient lighting between samples schools and schools with missing data, $\chi^2 = 0.90$, $p = .761$.

Noisy environment captures the noise level of the school. Listed in the 2002 school facilities checklist, the ordinal, four-category variable BYF02 documents the noise level of the main entrance when students are in class: noise level is about the sound of (a) a whisper, (b) a normal conversation, (c) yelling, and (d) a busy street. It was then recoded into a dichotomous variable, NOISE, with 0 indicating a noise level about the sound of a whisper or a normal conversation and 1 implying a noise level about the sound of yelling or a busy street. In the analytical sample, 98% of the schools were reported to have low level noise (see Table 7). Further, the statistics suggests there is no significant difference in the noise level between samples schools and schools with missing data, $\chi^2 = 0.47$, $p = .495$.

Fully computerized campus means complete accessibility of computers in the schools. Listed in the 2002 school administrator questionnaire, five dichotomous variables document whether computers are located in the administrative offices (BYA44A), teacher working rooms (BYA44B), classrooms (BYA44c), library media center (BYA44D), and separate computer lab (BYA44E). These items were then converted into the dichotomous variable COMPUTER, with 1 representing administrative offices, teacher working rooms, classrooms, library media center, and separate computer lab are all equipping with computers, and 0 indicating not all 5 places are equipped with computers. In the analytical sample, 71% of the schools have computers in all five spaces (see Table 7). In addition, the statistics suggests the samples schools are much more likely to be fully computerized than schools with missing data, $\chi^2 = 64.74$, $p < .001$.

School milieu variables.

High concentration of minority students refers to that most of the students are ethnic minorities. The variable CP02PMIN documented the percentage of ethnic minority students as indicated in the CCD 2001-2002. Due to its bimodal distributions with 70% as the lowest point of the distribution, it was converted into a dichotomous variable, H_MIN, with 0 indicating 69% or less of students are ethnic minorities and 1 indicating 70% or more of students are ethnic minorities. In the analytical sample, 16% of schools have a high concentration of ethnic minority students (see Table 7). Further, the statistics suggests that comparing to the sampled schools, schools with missing data are much more likely to be high minority ones, $\chi^2 = 31.62$, $p < .001$.

School average SES represents the average student family SES at school level. The variable BYSCHSES was computed to be the standardized (i.e. *z*-score transformation) aggregated value of individual 10th-grader SES in 2002 (BYSES2), which is a composite measure based on guardians' education attainment and occupations and family income in 2002. The ICC and lambda-hat coefficients are shown in Table 5. An ICC of .20 means that one-fifth of the variance in the 2002 mean student SES was accounted for by between-school differences. A lambda-hat of .79 indicates that the school mean is a reliable estimate. In addition, the statistics suggests that sampled schools were much more likely to locate in higher SES communities than schools with missing values, mean difference = 0.34, t = 3.71, p < .001 (see Table 7).

School average achievement refers to the average student mathematics performance at school level, which are measured by the standardized (i.e. z-score transformation) aggregated values of 10th-grade mathematics IRT scores in 2002. The variable BYTXMIRR indicates the mathematics IRT estimated number right score in 2002. From this, a school-level variable was created—the variable BYSCHMTH is the standardized aggregated value of BYTXMIRR. The ICC and lambda-hat coefficients are shown in Table 5. An ICC of .17 means that more than one-sixth of the variance in the 2002 mathematics achievement was accounted for by between-school differences. A lambda-hat of .75 indicates that the school mean is a reliable estimate. Further, the statistics suggests that sampled schools had higher average 10th-grade achievement than schools with missing values, mean difference = 0.39, t = 4.26, p < .001 (see Table 7).

High rate of full-teacher certified represents that most of the full-time teachers are certified. Drawn from the 2002 school administrator questionnaire, the item BYA24A documents the percentage of full-time teachers certified. Because the data are highly skewed to the left, it was converted into a dichotomous variable, H_FTCHC, with 1 indicating 90% or more of full-time are teachers certified and 0 indicating the rate is 89% or less. In the analytical sample, 76% of the schools have 90% or more of full-time teacher certified (see Table 7). Further, the statistics suggests there is no significant difference in the distribution of teacher certified rate between sampled schools and schools with missing data, $\chi^2 = 0.55$, $p = .459$.

Counselor-student ratio measures the ratio of students to school counselors. The ratio was created by dividing the number of school counselors, BYA23K, by the number of students enrolled in each school, CP02STEN. The average ratio is .003, with a SD of .002. Because the distribution is highly skewed to the left, a log transformation was then adopted to create the log-transformed counselor-student ratio, LCNSTDR. The statistics suggests that there is no significant difference in mean log ratio between sampled schools and schools with missing data, $t = -.00$, $p = .984$ (see Table 7).

School social system variables.

General positive climate refers to a positive atmosphere among and a rewarding relationship between teachers and students. The standardized (i.e. *z*-score transformation) variable BYSCHGPC is a composite scale consisting of six variables from the 2002 student questionnaire (see Appendix A for more details). Table 5 displays the ICC, lambda-hat, and alpha coefficients. An ICC of .09 means about 10% of the variance in general positive climate were accounted for by between-school differences. The reliability estimate, lambda-hat, is nearly .6, implying that the school mean is a fairly reliable estimate. An alpha of .79 suggests high consistency in scores among items for the composite scale. Further, the statistics suggests there is no significant difference between sampled schools and schools with missing values, $t = -0.16$, $p = .873$ (see Table 7).

Environmental incivility represents the extent to which students are exposed to bullying and delinquency. The continuous variable BYSCHEI is a composite scale comprising six variables from the 2002 student questionnaire (see Appendix A for more details). Table 5 displays the ICC, lambda-hat, and alpha coefficients. An ICC of .07 means less than one-tenths of the variance in environmental incivility was accounted for by between-school differences. The reliability estimate, lambda-hat, is above .5, implying that the school mean is a fairly reliable estimate. An alpha of .78 suggests high consistency in scores among items for the composite scale. In addition, the statistics suggests that sampled schools displayed more environmental incivility than schools with missing values, mean difference = 0.23, t = 2.46, p = .014 (see Table 7).

School safety refers to the perception of safety, including violence and gang issues, in the school. The continuous variable BYSCHSS is a composite scale based on four variables from the 2002 student questionnaire (see Appendix A for more details). Table 5 displays the ICC, lambda-hat, and alpha coefficients. An ICC of .27 means that more than a quarter of the variance in school safety was accounted for by between-school differences. The reliability estimate, lambda-hat, is above .8, implying that the school mean is a reliable estimate. An alpha of .75 suggests high consistency in scores among items for the composite scale. Further, the statistics suggests that sampled schools were safer than schools with missing values, mean difference = 0.23, t = 2.45, p = .015 (see Table 7).

School culture variables.

Academic press indicates a normative emphasis on academic excellence and conformity to high academic standards. The continuous variable BYSCHAP is a composite scale comprising of three variables from the 2002 school administrator questionnaire that measuring the extent to which teachers press students to achieve academically (BYA51B), students place a high priority on learning (BYA51D), and students are expected to do homework (BYA51E) from the principle's viewpoint. The scale scores were computed based on factor loadings of each item and were then transformed into *z*-scores for analysis. An alpha of .81 suggests high consistency in scores among the three items. In addition, the statistics suggests there is no difference in academic press between sampled schools and schools with missing values, $t = 0.67$, $p = .50$ (see Table 7).

Individual-level control variables. Some individual-level characteristics (i.e., reflecting differences between persons rather than between schools) that are basic demographic variables proved to be associated with academic performance were included in the analysis as control variables.

Ethnicity is represented by students' ethnic self-identification in the 2002 student questionnaire. From the seven-category variable BYRACE, six dummy coded (0,1) variables were created—European American (WHITE), Latino/a (LATINO), African American (BLACK), Asian/Pacific Islander (ASIAN), Multiracial (MULTI), and Native American (NATIVE). In the analysis, European American students were treated as reference group. After weighting, approximately 67% of sampled students were self-identified as European American, followed by African American (12%), Latino/a American (12%), Asian or Pacific Islander (4%), Multiracial (4%), and American Indian or Alaska Native (1%) (see Table 6). The result of chi-square test shows that there are statistically significant differences in the distribution of sampled and missing cases across ethnic groups, $\chi^2 = 17.78$, $p < .000$. Table 6 illustrates that it is much more likely to have higher percentages of missing data then expected for Latino/s, African, Asian, and

Native American students; whereas it is less likely to have missing data for their White and Multiracial counterparts.

Gender is students' self-reported gender. From the dichotomous variable BYSEX in the 2002 student questionnaire, a dummy coded (0,1) variable was created—Male (MALE) and female (FEMALE)—and female students were treated as reference group in the analysis. In the analytical sample, 50% of the students are females (see Table 6). Further, the statistics suggests there is no significant difference in gender distribution between sampled students and students with missing data, $\chi^2 = 0.06$, $p = .804$.

Highest Mathematics Course Taken in 12th-grade is an ordinal variable, F1HIMATH, documenting the highest level of mathematics course taken when students were surveyed in 12th-grade in 2004. The higher the values, the more advanced level courses had taken. In the analytical sample, 45% of the students had taken Trigonometry, Pre-calculus, or Calculus; 31% had taken Algebra II; 13% had taken Geometry; 6% had taken Algebra I; 4% had taken Pre-algebra, General, or Consumer Math; and less than 1% had not taken any mathematics course (see Table 6). In addition, the statistics indicates that comparing to students with missing data, the sampled students were much more likely to take advanced courses, $\chi^2 = 41.37$, $p < .001$.

SES represents students' family SES. The continuous variable BYSES2 is a composite measure based on guardians' education attainment, occupations, and family income in 2002. The statistics indicates that sampled students had much higher family SES than those with missing values, mean difference = 0.16, $t = 9.15$, $p < .001$ (see Table 6).

Student prior achievement is illustrated by 10th-grade mathematics and reading

IRT scores in 2002. The variable BYTXMIRR indicates the mathematics IRT estimated number right score in 2002, and the variable BYTXRIRR indicates the reading IRT estimated number right score in 2002. The statistics suggests that sampled students scored much higher than those who were dropped from the analysis, mean difference = 2.94, t = 10.36, $p < .001$ (see Table 6).

Student's educational aspirations refer to a student's perceptions of intention to pursue or obtain additional education in the future. The ordinal, eight-category variable BYSTEXP documents how far in school the 10th-grader thinks he or she will get in 2002. Because the data are highly skewed to the right, i.e. most students thought they would go to college, it was converted into a dichotomous variable, STDEA, with 0 indicating students expected not graduating from high school or a high school degree/diploma only, and 1 indicating going to college or graduate school. In the analytical sample, 93% of the students expected themselves to go to college (see Table 6). Further, the statistics suggests that compared to the analytical sample, students with missing values were more likely to have lower educational aspirations, $\chi^2 = 7.27$, $p = .007$.

Educational expectation of parents represents parents' expectation of future educational attainment for their children. The ordinal, seven-category variable BYPARASP documents how far in school the parents expect their 10th-graders to go in 2002. Because the data are highly skewed to the right, i.e. most parents thought they kid would go to college, it was converted into a dichotomous variable, PATEE, with 0 indicating an expection of graduating from high school or a high school degree/diploma only, and 1 indicating going to college or graduate school. In the analytical sample, 97% of the parents expected their kid to go to college (see Table 6). Further, the statistics suggests that compared to the sampled parents, parents who were dropped from the analysis were more likely to have lower educational aspirations, $\chi^2 = 14.93$, $p < .001$.

Peer educational aspiration refers to the view and perception of the importance of education for students' best friends. The continuous variable PEEREDAS is an index created by the average of the three variables listed in the 2002 student questionnaire that document the importance of having good grades to the 10th-graders' first (BYS25EA), second (BYS25EB), and third (BYS25EC) best friends. Due to its bimodal distributions, it was recoded into a dichotomous variable with 0 indicating it is not that important to have good grades and 1 indicating it is important. In the analytical sample, 43% of the students were classified as having high peer education aspiration (see Table 6). In addition, the statistics shows that the sampled students tended to have higher peer educational aspiration than students with missing values, $\chi^2 = 4.86$, $p = .027$.

Analytical Procedure

A series of correlation and regression analyses was conducted using hierarchical linear modeling 6.0 (HLM) to answer the research questions. The multilevel statistical technique has many advantages over the more basic ordinary least squares (OLS) regression modeling. In the past, researchers had to either aggregate individual-level data to the school level, or disaggregate school-level data to the individual level. Because students are nested within schools and are not statistically independent observations, the OLS regression techniques may underestimate the standard errors, which may lead to incorrect interpretations of statistical and substantive significance of the predictor variables (Luke, 2004; Raudenbush & Bryk, 2002). On the contrary, the multilevel statistical technique fits the regression equation at the individual level and, meanwhile, lets the parameters of the regression equation vary by school membership (Luke, 2004; Raudenbush & Bryk, 2002). It also explains variation in the individual-level parameters with the effects of school-level variables (Luke, 2004; Raudenbush & Bryk, 2002). Considering the above reasons, HLM was employed for the analysis.

For question 1a, the zero-order correlation coefficients between student individual characteristics and 12th-grade mathematics achievement were calculated. Because the statistical significance of correlation coefficients between some individual characteristics flags possible multicollinearity, multicollinearity diagnostic analysis was conducted. Secondly, a within-school regression model was estimated with the 12th-grade mathematics achievement as the response variable and with student individual characteristics as level-1 predictor variables. Ethnicity and family SES were entered into the equation for testing the achievement gaps along the lines of ethnicity and SES. In order to maximize prediction, the entering sequence for other variables was based on the absolute values of the zero-order correlation coefficients, which started from the mathematics achievement in 10th-grade and end up with peers' educational aspiration. Student individual characteristics were first entered into the equation as school-mean centered with slopes randomly varying across schools to test their homogeneity. When the relationship between a specific student individual characteristic and 12th-grade mathematics achievement significantly varies across schools, that particular individual characteristic was then included in the level-1 model as grand-mean centered with slopes randomly varying across schools. When the relationship does not vary across schools, the individual characteristic was then entered as grand-mean centered and fixed.

For question 1b, the simple correlation coefficients between the 12th-grade mathematics achievement and the selected school ecology, milieu, social system, and culture variables were first calculated. Because the statistical significance of correlation coefficients between some individual characteristics flags possible multicollinearity, multicollinearity diagnostic analysis was conducted. From this, the school ecology, milieu, social system, and culture variables were then put into the equation one by one as level-2 predictors. In order to maximize prediction, the entering sequence was based on the absolute values of the zero-order correlation coefficients, which started from the average 10th-grade mathematics achievement and end up with insufficient lighting and environmental incivility. Further, the influence of school climate variables on the individual characteristics-achievement slopes was tested separately with those individual characteristics school-mean centered.

Summary

The study is designed to determine which school climate variables based on Tagiuri's (1968) framework are significantly related to student mathematics achievement in public high schools. Drawn from the ELS:2002 public-use data, the sample contains 7,279 students of 416 public high schools, and variables measuring school ecology, milieu, social system, and culture are obtained from the student questionnaire, parent questionnaire, administrator questionnaire, and facility checklist. With the use of multilevel regression technique, the study resulted in a predictive model that helps understand whether or not and to what extent academic performance can be explained by its surrounding school physical, interpersonal, and psychological environment.

Chapter 4

Results

Are the Individual Characteristics of Public High School Students Significantly Associated with Mathematics Achievement?

The zero-order correlation coefficients between selected individual characteristics and 12th-grade mathematics achievement were calculated (see Table 8). The results suggest that all individual characteristics, except being Multiracial, were statistically significantly correlated to 12th-grade mathematics achievement at the .05 level. Mathematics achievement in 10th-grade was the best predictor of mathematics achievement in 12th-grade, $r = .90$, $p < .000$, following by the highest mathematics course taken in 12th-grade, $r = .56$, $p < .000$, family SES in 10th-grade, $r = .42$, $p < .000$, and being European American, $r = .31$, $p < .000$. The absolute values of Pearson's r for Latino/a American, African American, Asian American, Native American, Male, student's educational aspiration, parental educational expectation, and peers' educational aspiration are all less than .30, suggesting that small relations existed between the above variables and mathematics achievement in 12th-grade.

The statistical significance of the correlation coefficients between some individual characteristics flags possible multicollinearity. Table 9 summarizes the results of multicollinearity diagnostic statistics produced by linear regression analysis. The tolerance is above .40 and the variable inflation factor (VIF) is under 2.5 for all variables, which suggests that multicollinearity may not be a threat. The largest value for the condition index is greater than 15 but less than 30, suggesting multicollinearity is a moderate concern in interpreting the results.

The within-school model was first run with 12th-grade mathematics achievement as the response variable and with no predictor, i.e. the fully unconditional model (see Table 10 column 0). Student ethnicity and family SES were then put into the equation as level-1 predictors for testing the achievement gaps along the lines of ethnicity and SES. Initially ethnicity and family SES were entered into the model with group-mean centered with slopes randomly varying across schools to test their homogeneity. Because the results of the homogeneity test indicate that the relationships between ethnicity, SES, and mathematics achievement did not significantly vary across schools at the .05 level, ethnicity and family SES were entered as grand-mean centered and fixed in the second-run. Table 10 column 1 summarizes the results of the analysis. The average 12th-grade mathematics achievement adjusting for differences across schools was not statistically significantly different from the overall mean, p = .500. The results also suggest that the mathematics achievement gaps did exist between public high school students of different ethnicities and SES. On average, African American students scored about two-thirds of a SD behind their European American peers, $\beta = -.66$, $p < .000$, followed by Native Americans, $\beta = -.61$, $p < .000$, Latino/a Americans, $\beta = -.34$, $p < .000$, and Multiracial students, $\beta = -.24$, $p = .005$. Asian American students, on the contrary, did not perform statistically differently from European Americans, $p = .050$. One can also find a strong positive relationship between family SES and the 12th-grade mathematics achievement, $b = .43$, $p < .000$, which implies that the higher SES, the better mathematics performance. The variance of level-1 effect drops from .78 in the fully unconditional model to .69, which suggests that about 12% of the individual variance in mathematics achievement was explained by ethnicity and SES in 10-grade. The variance of average 12th-grade mathematics achievement drops from .14 to now .05, meaning that 64% of the between-school variance in achievement was explained by individual ethnicity and SES.

Mathematics achievement in 10-grade was then put into the model as group-mean centered with slopes randomly varying across schools. The result of the homogeneity test supports that the relationship between the 10th-grade and 12th-grade mathematics achievements significantly varied across schools, p = .036, so that later it was modeled separately for testing the cause of the differences. To control for the individual differences of the students, mathematics achievement in 10th-grade was put into the model as grand-mean centered with slopes randomly varying across schools. Table 10 column 2 summarizes the results of the analysis. The results indicate that mathematics achievement in 10-grade accounted for most of the ethnic and SES achievement gaps in 12th grade. When taking family SES and 10th-grade mathematics achievement into consideration, there was no significant difference in 12th-grade mathematics achievement between Black, Latino/a, Multiracial, Native American, and White students. Asian American students performed slightly better than their White counterparts, β = .10, p = .003. Small and statistically significant positive relationships existed between family SES, b = .08, p < .000, mathematics achievement in 10-grade, b = .07, p < .000, and mathematics achievement in 12-grade. The variance of level-1 effect drops from .69 in the previous model to .19, which suggests that additional 72% of the individual variance in mathematics achievement was explained by individual mathematics achievement in 10-grade. The variance of 12th-grade average mathematics achievement drops from .05 in the previous model to now .00, meaning that all the between-school variance in achievement was explained by individual ethnicity, SES, and academic performance in 10th grade.

The highest mathematics course taken in 12th-grade was put into the equation as group-mean centered with slopes randomly varying across schools afterwards. The result of the homogeneity test supports that the relationship between the highest math course taken and mathematics achievement in 12th-grade significantly varied across schools, $p < .000$, so that later it was modeled separately for testing the cause of the differences. To control for the individual differences of the students, the highest mathematics course taken in 12th-grade was put into the model as grand-mean centered with slopes randomly varying across schools. Table 10 column 3 summarizes the results of the analysis. There was no significant difference in 12th-grade mathematics achievement between Latino/a, Asian, Multiracial, Native American, and White students. The Black-White achievement gap, however, became wider, $\beta = -.07$, $p < .000$. The highest mathematics course taken in 12th-grade, $\beta = .14$, $p < .000$, mathematics achievement in 10-grade, $b = .07$, $p < .000$, and family SES, $b = .06$, $p < .000$, were significantly positively associated with mathematics achievement in 12-grade, though their effect sizes are small. The variance of level-1 effect drops from .19 in the previous model to .16, which indicates that an additional 16% of the individual variance in mathematics achievement was explained by the highest mathematics course taken in 12th-grade.

Student's educational aspiration and parental educational expectation were entered into the equation sequentially. They were first run as group-mean centered with slopes randomly varying across schools. Because the results of the homogeneity test indicate that the relationships did not significantly vary across schools at the .05 level, they were then entered as grand-mean centered and fixed. Table 10 column 4 and 5 summarize the results of the analysis. In terms of ethnicity, African American students achieved slightly poorer than their European American peers, $\beta = -.07$, $p < .000$. The highest mathematics course taken in 12th-grade, $\beta = .14$, $p < .000$, mathematics achievement in 10-grade, $b = .07$, $p < .000$, and family SES, $b = .05$, $p < .000$, still had small but significantly positive influence on mathematics achievement in 12-grade. Meanwhile, student's educational aspiration, $p = .875$, and parental educational expectation, $p = .249$, were not significantly correlated to the response variable.

Male was put into the equation with group-mean centered with slopes randomly varying across schools at first. Because the results of the homogeneity test indicate that the relationships did not significantly vary across schools at the .05 level, it was then entered as grand-mean centered and fixed. The results did not change much (see Table 10 column 6). African American students performed slightly poorer than their European American counterparts, $\beta = -.08$, $p < .000$. The highest mathematics course taken in 12th-grade, $\beta = .15$, $p < .000$, mathematics achievement in 10-grade, $b = .06$, $p < .000$, and family SES, $b = .05$, $p < .000$, showed small but significantly positive influence on mathematics achievement in 12-grade.Being male was positively correlated to mathematics achievement, $\beta = .08$, $p < .000$, though the effect size is small.

Peers' educational aspiration was first entered into the model with group-mean centered with slopes randomly varying across schools. Because the results of the homogeneity test indicate that the relationships did not significantly vary across schools at the .05 level, it was then entered as grand-mean centered and fixed. Table 10 column 7 summarizes the results. African American students performed slightly poorer than their

European American counterparts, $\beta = -.08$, $SE = .02$, $p < .000$. The highest mathematics course taken in 12th-grade, $\beta = .14$, $SE = .01$, $p < .000$, mathematics achievement in 10-grade, $b = .07$, $SE = .00$, $p < .000$, and family SES, $b = .05$, $SE = .01$, $p < .000$, had small but significantly positive influence on mathematics achievement in 12-grade. Student's educational aspiration, $p = .199$, parental educational expectation, $p = .479$, and peers' educational aspiration , $p = .050$, were not significantly associated with the response variable. Meanwhile, being male was positively correlated to mathematics achievement, $\beta = .08$, $SE = .02$, $p < .000$, though the effect size is small.

Are Variables Representing School Ecology, Milieu, Social System, and Culture Significantly Associated with Mathematics Achievement of Public High School Students beyond the Variance Accounted for by Their Individual Characteristics?

The zero-order correlation coefficients between the school ecology, milieu, social system, and culture variables and 12th-grade mathematics achievement were calculated. Table 11 summarizes the results. The results suggest that average mathematics achievement in 10th-grade, $r = .95$, $p < .000$, average student SES, $r = .72$, $p < .000$, high concentration of minority students, $r = -.45$, $p < .000$, and academic press, $r = .41$, $p < .000$, were strongly associated with the average mathematics achievement in 12th-grade. School safety, $r = .34$, $p < .000$, was moderately correlated to the response variable. Noisy environment, $r = -.23$, $p < .000$, fully computerized campus, $r = .19$, $p < .000$, all full-time teachers certified, $r = .18$, $p < .000$, general positive climate, $r = .16$, $p < .000$, and large school, $r = .11$, $p = .007$, were slightly associated with average mathematics achievement in 12th-grade. Small school, $p = .098$, medium school, $p = .244$, very large school, $p = .864$, insufficient lighting, $p = .124$, counselor-student ratio,

p = .055, and environmental incivility, p = .094, were not statistically significantly correlated to the response variable.

Some school climate variables were also statistically significantly associated with each other. The strong correlations between average student SES and average mathematics achievement in 10th-grade, $r = .72$, $p < .000$, between high concentration of minority students and average mathematics achievement in 10th-grade, $r = -.47$, $p < .000$, and between average student SES and high concentration of minority students, $r = -.41$, $p < .000$, suggest that schools with higher ethnic minority enrollment and poverty concentration were more likely to have poorer school performance. Average student SES, $r = .43$, $p < .000$, and average mathematics achievement in 10th-grade, $r = .40$, $p < .000$, were strongly associated with academic press, which imply that an achievement-oriented climate was more likely to happen in schools with more socioeconomically and academically advantaged students.

The significance of correlation coefficients between some school climate variables flags possible multicollinearity. Table 12 summarizes the results of multicollinearity diagnostic statistics produced by linear regression analysis. The tolerance is under .40 and the variable inflation factor (VIF) is over 2.5 for medium school, large school, and average mathematics achievement in 10th-grade, which indicates that multicollinearity may be a threat for these three variables. High correlations between pairs of coefficients (i.e., medium school and school safety, $r = .52$, large school and school safety, $r = .59$, average mathematics achievement in 10th-grade and general positive climate, $r = .80$) imply possible collinearity problems with the paired variables. The largest value for the condition index is greater than 30, suggesting multicollinearity can be a serious concern in interpreting the results.

The school ecology, milieu, social system, and culture variables were put into the equation as level-2 predictors, with standardized 12th-grade mathematics achievement as the response variable and with individual characteristics as level-1 predictors. In order to maximize prediction, the entering sequence was based on the absolute values of the zero-order correlation coefficients, which started from school-average 10th-grade mathematics achievement (i.e. the one with the biggest absolute value) and ended up with insufficient lighting and environmental incivility (i.e. the two with the smallest absolute value).

Average mathematics achievement in 10th-grade was put into the model with grand-mean centered. Table 13 column 1 summarizes the results. Average mathematics achievement in 10th-grade was a significant predictor of the average mathematics achievement in 12th-grade, $\beta = .05$, $p < .000$, but the result of chi-square test rejects the existence of a significant contextual effect, $\chi^2 = 1.73$, $p = .185$. Individual mathematics achievement in 10th-grade was also positively correlated to mathematics achievement in 12th-grade, $b = .07$, $p < .000$. The highest mathematics course taken in 12th-grade was another significant predictor of the response variable, $\beta = .14$, $p < .000$. While there was no significant difference in achievement between Latino/a, Asian, Multiracial, Native, and European American students, Black youth performed slightly poorer than their White counterparts, $\beta = -.06$, $p = .014$. Male, $\beta = .08$, $p < .000$, and higher SES, $b = .04$, $p = .004$, were also positively associated with better performance, though the effect sizes are small.

Average student SES was then put into the equation with grand-mean centered, followed by uncentered high concentration of ethnic minority students, grand-nean centered academic press, grand-mean centered school safety, uncentered noisy environment, and uncentered fully computerized campus. Table 13 column 2 to 7 summarize the results. When controlling for student individual characteristics and school average achievement, average student SES, p = .181, high concentration of ethnic minority students, p = .834, academic press, p = .052, school safety, p = .407, noisy environment, p = .258, and fully computerized campus, p = .108, were not significant predictors of academic performance. The direction and effect size for other variables remain nearly the same. Average mathematics achievement in 10th-grade was a significant predictor of average mathematics achievement in 12th-grade, β = .04, p = .010, but the result of chi-square test rejects the existence of a significant contextual effect. Individual mathematics achievement in 10th-grade, b = .07, p < .000, the highest mathematics course taken in 12th-grade, β = .14, p < .000, individual family SES, b = .03, p = .016, and being male, β = .08, p < .000, were positively correlated to mathematics achievement in 12th-grade. Being African American, β = −.05, p = .025, was negatively associated with mathematics achievement in 12th-grade.

High rate of full-time teachers certified was put into the model uncentered. Table 13 column 8 summarizes the results. Full-time teacher certified as a school-level variable showed no influence on the outcome variable in the model at the .05 level. Academic press, β = −.02, p = .038, became a negative predictor of mathematics achievement in 12th-grade. Considering its strong association with average mathematics achievement in 12th-grade reported in zero-order correlation, it is a sign of multicollinearity. The direction and effect size for other variables remain nearly the same.

Grand-mean centered general positive climate, uncentered school size, grand-mean centered counselor-student ratio, grand-mean centered environmental incivility, and uncentered insufficient lighting were put into the equation sequentially. Table 13 column 9 to 13 summarize the results. The final statistical model is shown below:

Level-1 Model

12th-grade Mathematics Achievement = $\beta_0 + \beta_1$ (***Mathematics Achievement in 10th-grade***) + β_2 (***Highest Math Course Taken in 12th-grade***) + β_3 (***Latino/a***) + β_4 (***African American***) + β_5 (***Asian American/Pacific Islander***) + β_6 (***Multiracial***) + β_7 (***Native American***) + β_8 (***Male***) + β_9 (***Student Family SES***) + β_{10} (***Student's Educational Aspiration***) + β_{11} (***Parental Educational Expectation***) + β_{12} (***Peers' Educational Aspiration***) + β_{13} (***Individual-reported General Positive Climate***) + β_{14} (***Individual-reported Environmental Incivility***) + β_{15} (***Individual-reported School Safety***) + r

Level-2 Model

$\beta_0 = \gamma_{00} + \gamma_{01}$ (***Average Mathematics Achievement in 10th-grade***) + γ_{02} (***Average Student SES***) + γ_{03} (High Concentration of Minority Students) + γ_{04} (***Academic Press***) + γ_{05} (***School Safety***) + γ_{06} (Noisy Environment) + γ_{07} (Fully Computerized Campus) + γ_{08} (High Rate of Certified Full-time Teacher) + γ_{09} (***General Positive

$$\textit{\textbf{Climate}}) + \gamma_{010} \text{ (Medium School)} + \gamma_{011} \text{ (Large School)} + \gamma_{012}$$

$$\text{(Very Large School)} + \gamma_{013} (\textit{\textbf{Counselor-student Ratio}}) + \gamma_{014}$$

$$(\textit{\textbf{Environment Incivility}}) + \gamma_{015} \text{ (Insufficient Lighting)} + u_0$$

$$\beta_1 = \gamma_{10} + u_1$$

$$\beta_2 = \gamma_{20} + u_2$$

$$\beta_3 = \gamma_{30}$$

$$\beta_4 = \gamma_{40}$$

$$\beta_5 = \gamma_{50}$$

$$\beta_6 = \gamma_{60}$$

$$\beta_7 = \gamma_{70}$$

$$\beta_8 = \gamma_{80}$$

$$\beta_9 = \gamma_{90}$$

$$\beta_{10} = \gamma_{100}$$

$$\beta_{11} = \gamma_{110}$$

$$\beta_{12} = \gamma_{120}$$

$$\beta_{13} = \gamma_{130}$$

$$\beta_{14} = \gamma_{140}$$

$$\beta_{15} = \gamma_{150}$$

Average mathematics achievement in 10th-grade, $\beta = .04$, $SE = .01$, $p = .011$, was a significant predictor of mathematics achievement in 12th-grade, but the result of chi-square test rejects the existence of a significant contextual effect, $\chi^2 = 0.06$, $p > .5$.

Academic press, $\beta = -.02$, $SE = .01$, $p = .020$, was a negative predictor of mathematics achievement in 12th-grade, but it is very likely due to collinearity problem. All other school climate measures were not significantly associated with the outcome variable at the .05 level.

Individual mathematics achievement in 10th grade, $b = .07$, $SE = .00$, $p < .000$, the highest mathematics course taken in 12th grade, $\beta = .14$, $SE = .01$, $p < .000$, individual family SES, $b = .03$, $SE = .01$, $p = .017$, and being male, $\beta = .08$, $SE = .02$, $p < .000$, were positively correlated to mathematics achievement in 12th grade. African American students, $\beta = -.05$, $SE = .02$, $p = .025$, on average, performed slightly poorer than their White peers. No significant difference in 12th-grade mathematics achievement was found between Latino/a, Asian American, Multiracial, Native American, and White students at the .05 level. Student's educational aspiration, parental educational expectation, and peers' educational aspiration were not significantly associated with academic performance at the .05 level, either.

In addition, the results of the homogeneity test indicate that the relationship between 10th-grade and 12th-grade mathematics achievements, as well as the relationship between the highest mathematics course taken and mathematics achievement in 12th grade, significantly varied across schools. The two variables were modeled as group-mean centered with slopes randomly varying across schools to test the cause of the differences. Table 14 summarizes the influence of school climate on the 10th-grade to 12th-grade achievement slope. Fully computerized campus, $\beta = -.00$, $SE = .00$, $p = .035$, showed a close-to-zero and yet significant effect on the relationship between 10th-grade and 12th-grade mathematics achievement. In other words, the performance gap between high and low-achieving students was slightly narrower after two years in fully computerized schools. Average student SES showed a very small and positive effect on the relationship between 10th-grade and 12th-grade mathematics achievement, $\beta = .00$, *SE* = .00, *p* = .049. That is, the gap between high and low-achieving students became slightly wider after two years in schools locating in more affluent communities.

Table 15 summarizes the influence of school climate on the highest-level-of-mathematics -course-taken to 12th-grade achievement Slope. Average student SES had a small and negative effect on the relationship between the highest mathematics course taken and mathematics achievement in 12th-grade, $\beta = -.03$, *SE* = .02, *p* = .049. In other words, students in schools locating in economically disadvantaged communities were benefited more from taking advanced mathematics courses than their peers in more affluent schools. Average mathematics achievement in 10th-grade showed a small and positive influence upon the relationship between the highest mathematics course taken and 12th-grade mathematics achievement, $\beta = .04$, *SE* = .02, *p* = .029. That is, students in high performing schools were benefited more from the advanced mathematics courses than their peers in low performing schools.

Chapter 5

Discussion

This research studied the effects of school ecology, milieu, social system, and culture upon public high school students' achievement. Utilized data were collected from American youth during the spring term of their 10th grade year in 2002 to their 12th grade year in 2004. Two research questions were posed and a series of multilevel analyses were conducted to examine the influence of school climate on mathematics achievement. Several individual variables that have been proved to be associated with the outcome were also taken into consideration. In this chapter, the findings of this study are described for each research question. Recommendations for school counselors, education practitioners, and policy makers regarding effective school climate in helping all students achieve, as well as for future research on school climate, are provided. Limitations of the ELS: 2002 restricted-use data, sample, and research methods are outlined.

Individual Characteristics and Achievement

Are the individual characteristics of public high school students significantly associated with their mathematics achievement? The answer is yes. The results of this study suggest that ethnicity, gender, family SES, mathematics achievement in 10th-grade, and highest mathematics course taken in 12th-grade are significant predictors of mathematics achievement in 12th-grade.

First, the results mirror findings in the vast literature suggesting that performance gaps exist between public school 12th-graders of different ethnic groups and socioeconomic backgrounds. On average, students who self-identified themselves as multiracial score lower than their European and Asian American peers on mathematics achievement test. Latino/a, Native American, and African American students perform even lower than their multiracial counterparts. On the contrary, there is no achievement difference between Asian and European American students. Students from higher SES families also outperform their lower SES peers on mathematics achievement test. In addition, there is a substantial reduction in the variance of average 12th-grade mathematics achievement test scores once ethnicity and SES are controlled, meaning that most of the between-school variation in achievement are explained by student ethnicity and SES.

Lower SES and Latino/a, African American, and Native American students also arrive at high school with fewer academic skills. Once past performance in 10th-grade is controlled, the achievement differences in 12th-grade between ethnic and socioeconomic groups become much smaller or even nonsignificant. When taking achievement test scores in 10th grade into account, there is no difference in 12th-grade performance between Latino/a, Black, Multiracial, Native, and White students. The effect of student's family SES also becomes much smaller. It is increasing clear that most of the ethnic and socioeconomic gaps in 12th-grade mathematics performance turn out to be merely reflections of the differences that already existed two years prior in 10th-grade, just as national data reveal that the achievement gaps persist from pre-school through the secondary grades (Chatterji, 2006; Lee & Berkam, 2002; Phillips et al., 1998; U.S. Department of Education, 2004). The statistics also indicate a positive relationship between prior and later achievement. Students with higher mathematics achievement test scores in 10th-grade still perform better when they are in 12th-grade, but the gap between high and low achieving students becomes narrower from 10th-grade to 12th-grade. The results offer no plausible explanation. Maybe it is because many low-achieving students were not included in the analytical sample due to missing values or dropping out of schools; or schools and teachers did a better job in reducing the disparities among students; or students performed better in order to go to college as they approach graduation, or both. There is a substantial reduction in the variance of individual 12th-grade achievement test scores once mathematics performance in 10th-grade is controlled, meaning that most of the variation in individual achievement that are not explained by ethnicity and SES is explained by mathematics achievement in 10th-grade. Note worthily, the variance of average mathematics test scores drops to nearly zero once ethnicity, SES, and individual past performance are controlled, meaning that almost all the between-school variation in 12th-grade performance are explained by ethnicity, SES, and the individual academic differences that already existed two years prior in 10th-grade.

High school course taking in mathematics is organized in a hierarchical sequence. Individual courses are taught with progressive levels of difficulty so that skills and concepts build on one another throughout the sequence. Not surprisingly, the results show that the highest mathematics course taken in 12-grade produces a positive estimate of mathematics achievement in 12th-grade, and further accounts for some of the individual differences in 12th-grade mathematics achievement. The zero-order correlation also affirms what have been shown in the previous research that ethnic minority (more specifically, African American, Native American, Latino/a, and Multiracial Americans) and lower SES students are more likely to not be enrolled in the advanced level courses (Kelly, 2009; Ladson-Billings, 1997; Riegle-Crumb, 2006). It is important to note that

African American students benefit less from the advanced courses than their European American counterparts—the Black-White gap becomes significant again when the level of courses taking is controlled. In a literature review, Ferguson (2003) has suggested some facts that may help to explain the phenomenon, including that (a) some teachers perceive Blacks as having negative attitudes, demonstrating lower effort, and exhibiting less desirable behavior than Whites, which leads to unequal treatment of Black and White students; and (b) compared to White youth, Black students are less hopeful of and have more ambivalence about education as a way to success in the society.

The level-1 model also suggests that 12th-grade male students, on average, get higher scores in mathematics achievement test than their female peers do, even though the result of zero-order correlation is consistent with Frank and colleagues' (2008) study that girls are more likely to advance in mathematics courses. Students' educational aspiration and their parental educational expectation are universally high—more than 60% of students and 96% of parents expect that they will achieve at least an associate degree. But as suggested by previous research (e.g., Kao & Tienda, 1998; Shernoff & Schmidt, 2008) that both fail to predict academic performance in 12th grade. The classic view of peer influence is that adolescents conform to the expectations of peers in order to make and keep friends (Dornbusch 1989), but the educational aspiration of students' three best friends also fail to predict academic performance in 12th grade.

Overall, demonstrating prior achievement, taking advanced mathematics courses, coming from higher SES background, and being a male are significant predictors of mathematics success in 12th-grade. On the contrary, being an African American plays negative roles for mathematics performance in 12th-grade. In addition, the relationship between prior and later achievement, as well as between levels of mathematics course taking and achievement, varies across schools. The selected individual characteristics, together, account for approximately 81% of the individual variantion and almost all the between-school variation in mathematics achievement.

School Climate and Achievement

Are variables representing school ecology, milieu, social system, and culture significantly associated with mathematics achievement of public high school students beyond the variance accounted for by their individual characteristics? The statistical results suggest that school climate have small influence on student learning at the high school level, but almost all the between-school variation in mathematics achievement is accounted for by preexisting individual differences.

School ecology. Schools with administrative offices, teacher working rooms, classrooms, library media center, and separate computer lab all equipping with computers tend to be those with less ethnic minorities and locating in more affluent neighborhoods. These schools also have flatter 10th-grade-12th-grade achievement slopes. That is, the performance gap between high and low achieving students becomes slightly narrower from 10th-grade to 12th-grade in such schools. Despite lack of information regarding the roles of computers in learning in this study, Hannafin and Foshay's (2008) work provide a plausible explanation. They discovered that students at risk of failing the state mathematics tests benefit more from computer-based instruction than their high-ability peers.

In terms of school size, small schools (599 students or less) are more likely to be located in lower SES communities but safer on campus. On the contrary, large schools

(1,600-2,499 students) are more likely to be located in more affluent neighborhoods but have violence and gang activity on campus. Size is also associated with counselor-student ratio—the smaller the school, the better the ratio. Difference in school size does not matter to academic performance or to the relationship between prior and later achievement, when the selected individual and school climate variables are controlled. The statistics does not mirror the findings in majority literature of which focused on the influence of size and a few individual and school-level variables only. In other words, school size might not be an important matter for student learning outcomes.

Noisy environment and insufficient lighting do not produce any significant estimate with achievement, or alter the two modeled slops. A possible explanation is that most schools in the sample do not have noise or insufficient lighting problems—only 2% of the schools' noise level was about the sound of yelling or a busy street when students in class, and only 2% of the schools had broken lights in classrooms—so that they are no longer barriers for student learning. They may not be reliable and valid measures, either. These are single-shot one-item measures and do not provide such information as the amount of broken lights or noise level in the classrooms, which make their reliability and validity for depicting school environment questionable.

School milieu. Considering the high correlations among ethnicity, income, class, and neighborhood in the United States, it is not surprising to find significant relationships between school aggregate student characteristics and other school climate variables. School average achievement is positively correlated to campus computerization, average student SES, full-time teacher certified rate, counselor-student ratio, school safety, and academic press. It is also negatively correlated to concentration of ethnic minority students and environmental noise. School average prior mathematics achievement is positively associated with later mathematics achievement. The nonsignificance of contextual effect, however, suggests that school average performance does not add significant prediction to student learning after controlling for the individual-level performance. In other words, the differences across schools do not matter; rather, the differences among students do. School average mathematics achievement slightly influences the effect of highest mathematics course taken in 12th-grade. Specifically, students in high achieving schools benefit slightly more from the advanced mathematics courses than their peers in low achieving ones.

School average student SES is negatively associated with minority composition and campus safety, and positively correlated to full-time teacher certified rate and academic press. School average SES shows some tiny influence on the two modeled slopes, but does not produce a significant estimate with later mean performance. First of all, the average student SES shows a very small and negative influence on the relationship between the highest mathematics course taken and the mathematics achievement in 12th-grade. More specifically, students in schools located in economically disadvantaged communities make more gains in advanced mathematics course-taking than their peers in more affluent schools. Alexander, Entwisle, and Olson (2001) indicated that schools play an important compensatory role for lower SES students for whom family and community assistance and resources are often scarce. So taking advanced level courses is probably the only way for lower SES students to improve and compete academically with more affluent peers.

Secondly, the average student SES has a close-to-zero and positive effect on the relationship between prior and later achievement—after two years, the gap between high and low-achieving students grows slightly wider in schools located in more affluent communities. That is, more educational inequities can be found in such schools. However, it may not be due to the school itself. Alexander and colleagues (2001) suggested the increase in achievement gap can be traced mainly to the out-of-school environment. They discovered that school-year achievement gains are comparable for both higher and lower SES students, but during the summer, higher SES students' skills continue to advance while lower SES students remain the same.

High concentration of minority students (i.e. 70% or more of the students are ethnic minorities), higher rate of certified full-time teachers (i.e. 90% or more of full-time teachers certified), and counselor-student ratio do not produce any significant effect estimates with mean achievement, or alter the two modeled slops when other individual and school variables are controlled. For schools with high concentration of minority students, the result of simple correlation is consistent with current literature that these schools tend to have poor mean achievement. The results of simple correlation are also consistent with findings of existing studies that schools with 90% or more of full-time teachers certified tend to have higher mean SES, higher mean achievement, and less minority students. Both become nonsignificant, however, after taking mean prior achievement, mean student SES, and individual student characteristics into account. Perhaps it is the pre-existing individual differences that impede educational outcomes, not because of schools with more minority students or less certified full-time teachers. So does the counselor-student ratio. Despite some research showing that school counseling programs with an aim at identifying and eliminating systemic barriers that impede student academic success lead to better performance, a higher counselor-student ratio does not lead to higher achievement in the statistical models. Maybe it is just as what Holcomb-McCoy (2007) said, "[T]here is still much more that school counselors can do to help all students (particularly poor and ethnic minority students) achieve" (p. 4).

School social system. There is limited between-school variation in general positive climate and environmental incivility, suggesting schools look nearly the same in these two dimensions. The relatively large ICC for school safety indicates that there are some between-school variations in violence and gang activity on campus. School safety is associated with size, ethnic minority composition, and average student SES—schools of bigger enrollment, with more ethnic minority students, or locating in poorer communities have more violence and gang activities. It is also positively correlated to academic press. However, the three school social system variables do not produce any significant estimate with mean achievement, or alter the two modeled slops after other individual and school variables are controlled. For general positive climate and environmental incivility, maybe it is due to their lack of between-school difference. Considering the relatively large between-school variation in violence and gang activity, the only plausible explanation based on the statistical models is that the pre-existing individual differences are more salient predictors than school safety in predicting later mathematics achievement.

School culture. Academic press is correlated to ethnic minority composition, average student SES, school safety, and mean past achievement. The less ethnic minority students, higher neighborhood SES, less violence and gang activity on campus, or higher student past achievement, the higher is the press. Contrary to previous research, academic press has nothing to do with latter mean achievement or the two modeled slopes after taking average prior achievement, average SES, ethnic composition, and individual characteristics into consideration. Perhaps as suggested by the statistical models, the individual differences are more salient predictors than academic press. In addition, Murphy and colleagues (1982) defined academic press as “the degree to which environment forces press for student achievement on a schoolwide basis……it pulls together various forces—school policies, practices, expectations, norms, and rewards—generated by both staff and students” (p. 22). The composite scale comprises three items from the 2002 school administrator questionnaire only. Without including school policies, practices, and rewards, as well as views from teachers and students, the validity of academic press measured in this study is questionable.

Implications for School Counseling, Educational Practice, and Policy Development

The aim of this study was to understand the nature and role of school ecology, milieu, social system, and culture on the academic achievement of high school students. In view of the findings, the following recommendations are suggested to school counselors, education practitioners, and policymakers.

First, policies and interventions aimed at closing or narrowing the achievement gaps should target students during the earlier grades. The results of this study, as well as that of others (Chatterji, 2006; Lee & Berkam, 2002; Phillips et al., 1998; U.S. Department of Education, 2004), clearly show that the huge performance gaps exist before students start high school. Evidence even reveals the gaps are already there for children in preschool age (Chatterji, 2006; Lee & Berkam, 2002). Considering the nature of mathematics education—courses are taught with progressive levels of difficulty that skills and concepts build on one another, the magnitude of the influence may be substantial if effects accumulate from kindergarten through 12th-grade. In order to close the gaps in high school, ensuring that all students, especially those from lower SES backgrounds and of ethnic minorities, have access to effective and high quality teaching and remedies in preschool, primary, and secondary education is a must. Evidence reveals that professional school counselors can play a key role in narrowing the achievement gaps at elementary school level. Analyzing data from 150 Washington state public elementary schools, Sink and Stroh (2003) concluded that well-established comprehensive school counseling programs can significantly decrease educational disparities among students over a two to three year time period.

Further, additional effort is needed to promote the academic success of African American students. It is disturbing to see the huge Black-White achievement gap and, moreover, the gap exists even when all the conditions are equal. The results also reveal that African American students benefit less from the advanced level mathematics courses. Previous research suggests that bias in perceptions and expectations from teachers (Ferguson, 2003; Gross, 1993) has a negative effect on the academic development of young Blacks. Professional school counselors should work proactively to root out bias and create an environment supporting learning for them. Ferguson (2003) also suggested that responsive and stimulating instruction and corrective feedback may lead to more gains for African American students.

Third, encouraging enrollment in advanced level mathematics courses for all students may help to narrow the achievement gaps. This is especially true for ethnic minority and lower SES students because the results reveal their disappearance in advanced courses. The statistical models suggest that students from high schools located in economically disadvantaged communities also make more gains in advanced course-taking than their counterparts from schools in more affluent neighborhoods. Professional school counselors can play an important compensatory role in dealing with these issues. In most high schools, counselors are responsible for assisting students with planning and scheduling classes. They can become student advocates during the process by advocating for equal and wider access for information, resources, opportunities, and, of course, higher-level classes, regardless of students' ethnicity, socioeconomic background, and past performance. In so doing, ethnic minority and lower SES students will be able to improve academically and even to compete with their advantaged peers.

Forth, schools need computers. While the use of computers in schools has become more important and influential, this study further illustrates its potential for promoting educational equity. The statistics produced by the analytical sample suggest that the performance gap between high and low-achieving students becomes slightly narrower in schools with administrative offices, teacher working rooms, classrooms, library media center, and separate computer lab all equipping with computers.

Fifth, more effort is needed to promote the academic success of low-achieving students in more affluent schools. The study reveals that more educational inequities can be found in schools located in more affluent communities in which the gap between high and low-achieving students tends to slightly widen from 10th to 12th-grade. But without sufficient information to support a particular explanation, the only thing for sure is that low-achieving students do need some extra help in such schools.

Sixth, withdrawing students from an under-performing school and transferring them to a high-achieving one do not help boost students' academic performance. NCLB allows parents to relocate their children from the labeled "failing schools" to other higher-performing local schools. This study, however, does not supports the potential effectiveness of such transfers by showing the nonsignificant contextual effect of mean prior achievement—students in high-performing schools will not perform better academically.

Last, smaller schools do not necessarily lead to better performance at the high school level. The results of this study do not support the widespread agreement on the small school movement. The multilevel models show that difference in school size does not matter to student learning outcomes when the selected individual and school climate variables are controlled. Considering the reality of limited educational resources, school size reduction may not be the best investment in education reform.

Implications for Future Research

This study adds a great deal of understanding, as well as raises more questions, about the influence of school climate. Despite compelling empirical studies that show a solid relationship between school climate and achievement, the major concern is that previous research only focused on one or a few variables at a time. This study stands out from the rest by using a more inclusive framework, i.e. Tagiuri's (1968) taxonomy, to conceptualize school climate and, meanwhile, controlling for some important individual-level characteristics. The results reveal that almost all the between-school variation in 12th-grade performance are explained by preexisting individual characteristics, i.e., ethnicity, SES, and the individual academic differences that already existed two years prior in 10th-grade. Further, several school characteristics (school size, ethnic composition, teacher-student relationship, violence and gang activity, to name a few) may not be as important for student learning outcomes at the high school level as prior research suggests. A plausible explanation is that when estimating causal effects with observational data, most existing studies failed to include enough covariates related to the outcome to produce credible estimates. Care should be taken to adopt a more inclusive framework or at least to include enough control variables for future researchers to study school effects.

Secondly, it may be useful to reconsider the operational definition of academic press. In most existing studies, academic press was defined and measured by the level of staff expectations for students to succeed academically. However, Murphy and colleagues (1982) originally proposed a much broader definition, which includes not only expectations but also school policies, practices, norms, and rewards generated by both staff and students with an aim at pressing for achievement.

Further studies on educational inequity in more affluent schools, school disorder, and fully computerized campus upon achievement will yield more insights about their mechanisms. Special interest should be paid to the classroom-level variables that are not captured in this study. Eventually, experimental research with more reliable and valid measures is needed. Without testing whether student learning outcomes change following manipulation of school characteristics, the influence of climate will remain underestimated.

Limitations of the Study

There are several limitations to this study. First of all, the correlational nature of the observational data makes tests of causality uncertain. Even though this study is motivated by the desire to estimate the casual effect of school climate on high school student achievement and has taken many important covariates into account, the problems of making causal inferences based on nonrandom assignment to the predictor variables are considerable.

Second, attrition is a major threat. 26% of students and 28% of schools are not included in the analysis mostly because of missing values at the school level. Comparing to the analytical sample, the dropped students are more likely to score lower in both 10th and 12th-grade achievement tests, be ethnic minorities, have lower family SES, and take intro rather than advanced-level courses; and the dropped schools are more likely to be, lower SES, high minority, and low-achieving ones. In other words, a bunch of students at one end of the spectrum are missing. Restriction of the range of the variables further decrease the correlation between predictor and response variables, resulting in smaller parameter estimates.

Third, the scope of assessing Tagiuri’s (1968) framework is limited. Teacher quality, for instance, is proved to be associated with student academic performance. Indicators that have been used in prior research include teaching experience (Clotfelter et al., 2006; Goldhaber & Brewer, 1997; Powers, 2003; Rivkin et al., 2005; Rockoff, 2004), level of education (Goldhaber & Brewer, 1997; Powers, 2003), and credentials (Durán-Narucki, 2008; Goldhaber & Brewer, 1997; Powers, 2003). Only teacher credentials, however, was included in the analysis as a school milieu variable because it is the only one contained in the ELS:2002 dataset. In other words, the statistical model in this study is an underrepresentation of Tagiuri’s framework.

Last, the reliability and validity of some of the measures are questionable.

Insufficient lighting, for instance, is represented by one single-shot item documented by the survey administrator whether broken lights were observed in classrooms in which students are taught, lack of cross-validation and some key information such as the amount of broken lights and classrooms in each school.

Table 1

Comparison of Conceptualizations of School Climate with Tagiuri's (1968) Taxonomy

	Ecology	Milieu	Social System	Culture
McDill et al. (1966)			- student perception of intellectualism-estheticism	- Academic emulation - Scientism - Humanistic excellence - Academically oriented student status system
			- Cohesive and egalitarian estheticism	
Moos (1973)	- Ecological factors - Behavior settings	- Personal and behavioral characteristics of the inhabitants	- Organizational structure	- Functional or reinforcement properties
			- Psychosocial characteristics and organizational climate	
Moos (1979)	- Physical setting	- Human aggregate	- Organizational factors	- Social climate
Murphy et al. (1982)			- Policies on achievement - Practices on achievement	- Expectations of achievement - Norms for achievement - Rewards for achievement
Bryk & Driscoll (1988)			- Common agenda of activities	- Shared value system
		- Formal organizational characteristics		
Hoy & Tarter (1992)		For administrators: - Institutional integrity - Initiating structure - Consideration - Resource support For teachers: - Morale		- Teachers' sense of academic emphasis
Gottfredson (1999)				
For Students		- Social background	- Peer relations	- Attitudes and psychosocial development - Measures of school experiences
For Teachers		- Job satisfaction - Professional development	- Interaction with students - Classroom orderliness	- Pro-integration attitude - Nonauthoritarian attitudes - Personal security
Brand et al. (2003)		- Instructional innovation/ relevance	- Teacher support - Negative peer interactions - Positive peer interactions - Student input in decision making	- Consistency and clarity of rules and expectations - Student commitment/ achievement orientation - Disciplinary harshness - Support for cultural pluralism - Safety problems

Table 2

Number of Cases for Level-1 Variables (Unweighted)

Variables	Total Valid *N*	*N* in the Sample	Missing
Ethnicity	9,823	7,279	2,544
Gender	9,823	7,279	2,544
Family SES in 2002	9,823	7,279	2,544
10th-grade Math Achievement in 2002	9,823	7,279	2,544
Highest Math Course Taken in 12th-grade in 2004	9,731	7,279	2,452
Student's Educational Aspiration in 2002	9,823	7,279	2,544
Parental Educational Expectation in 2002	9,823	7,279	2,544
Peers' Educational Aspiration in 2002	9,242	7,279	1,963
12th-grade Math Achievement in 2004	9,823	7,279	2,544

Table 3

Number of Cases for Level-2 Variables

	Total Valid *N*	*N* in the Sample	Missing
School Ecology Variables			
School Size in 2002	574	416	158
Insufficient Lighting in 2002	567	416	151
Noisy Environment in 2002	554	416	138
School Computer Facility in 2002	577	416	161
School Milieu Variables			
Minority Composition in 2002	563	416	147
Average SES in 2002	577	416	161
Average 10th-grade Mathematics Achievement in 2002	577	416	161
High Rate of FT Teacher Certified	473	416	57
Counselor-student Ratio	563	416	147
School Social System Variables			
General Positive Climate in 2002	576	416	160
Environmental Incivility in 2002	576	416	160
School Safety in 2002	576	416	160
School Culture Variables			
Academic Press in 2002	576	416	160

Table 4

List of Original ELS:2002 Variables and Recoded Variable Labels

	Original Variable	Recoding Label
Response Variable		
12th-grade Mathematics Achievement in 2004	F1TXM1IR	ZF1STDM
School Ecology Variables		
School Size in 2002	CP02STEN	SMALL, MEDIUM, LARGE, V_LARGE
Insufficient Lighting in 2002	BYF05C	—
Noisy Environment in 2002	BYF02	NOISE
School Computer Facility in 2002	BYA44A, BYA44B, BYA44C, BYA44D, BYA44E	COMPUTER
School Milieu Variables		
Minority Composition in 2002	CP02PMIN	H_MIN
Average SES in 2002	BYSES2	BYSCHSES
Average 10th-grade Mathematics Achievement in 2002	BYTXMIRR	BYSCHMTH
High Rate of FT Teacher Certified	BYA24A	H_FTCHC
Counselor-student Ratio	BYA23K, CP02STEN	LCNSTDR
School Social System Variables		
General Positive Climate in 2002	BYS20F, BYS20E, BYS20G, BYS21B, BYS21C, BYS20B	BYSCHGPC
Environmental Incivility in 2002	BYS22H, BYS22C, BYS22E, BYS22G, BYS20I, BYS22F	BYSCHEI
School Safety in 2002	BYS20M, BYS20N, BYS20J, BYS20K	BYSCHSS
School Culture Variables		
Academic Press in 2002	BYA51B, BYA51D, BYA51E	BYSCHAP
Individual-level Control Variables		
Ethnicity	BYRACE	WHITE, LATINO, BLACK, ASIAN, MULTI, NATIVE
Gender	BYSEX	MALE, FEMALE
SES in 2002	BYSES2	—
Highest Math Course Taken in 12th-grade in 2004	F1HIMATH	—
10th-grade Math Achievement in 2002	BYTXMIRR	—
Student's Education Aspiration in 2002	BYSTEXP	STDEA
Educational Expectation of Parents in 2002	BYPARASP	PATEE

Peer Educational Aspiration in 2002	BYS25EA, BYS25EB, BYS25EC	PEEREDAS

Table 5

Descriptive Information on Student Achievement, Student SES, General Positive Climate, Environmental Incivility, and School Safety

Variable	*ICC*	Lambda-hat	Alpha
12th-grade Math Achievement in 2004	.16	.74	
10th-grade Math Achievement in 2002	.17	.75	
Student SES in 2002	.20	.79	
General Positive Climate in 2002	.09	.58	.79
Environmental Incivility in 2002	.07	.51	.78
School Safety in 2002	.27	.83	.75

Table 6
Individual Characteristics of Sampled and Omitted Students (Weighted)

	Sampled	Omitted
12th-grade Math Achievement in 2004 (standardized)	0.04	-0.12
10th-grade Math Achievement in 2002	39.07	36.13
Family SES in 2002	0.06	-0.10
Ethnicity		
European American	67.1 %	53.9 %
Latino/a American	11.9 %	19.8 %
African American	12.2 %	16.8 %
Asian American	4.0 %	4.3 %
Multiracial	4.0 %	3.9 %
Native American	0.9 %	1.3 %
Gender		
Female	49.7 %	49.4 %
Male	50.3 %	50.6 %
Highest Math Course Taken in 12th-grade in 2004		
Trigonometry, Pre-calculus, or Calculus	45.1 %	39.5 %
Algebra II	30.6 %	30.4 %
Geometry	13.2 %	15.2 %
Algebra I	6.0 %	7.9 %
Pre-algebra, General, or Consumer Math	4.2 %	5.4 %
None	0.8 %	1.6 %
Student's Educational Aspiration in 2002		
College or Graduate School	93.3 %	91.4 %
High School Only or Less	6.7 %	8.6 %
Parental Educational Expectation in 2002		
College or Graduate School	97.2 %	95.5 %
Less than College	2.8 %	4.5 %
Peers' Educational Aspiration in 2002		
High	42.9 %	40.2 %
Low	57.1 %	59.8 %

Table 7

School Climate Measures of Sampled Schools and Schools with Missing Data

	Mean		Percentage	
	Sampled	Missing	Sampled	Missing
School Ecology Variables				
School Size in 2002				
Small			19 %	14 %
Medium			42 %	37 %
Large			32 %	32 %
Very Large			8 %	17 %
Insufficient Lighting in 2002				
No Broken Lights			98 %	99 %
With Broken Lights			2 %	1 %
Noisy Environment in 2002				
Low Noise Level			98 %	97 %
High Noise Level			2 %	3 %
School Computer Facility in 2002				
Fully Computerized			71 %	34 %
Not Fully Computerized			29 %	66 %
School Milieu Variables				
Minority Composition in 2002				
69% or Less			84 %	62 %
70% or More			16 %	38 %
Average SES in 2002	0.09	-0.25		
Average Math Achievement in 2002	0.10	-0.28		
FT Teacher Certified Rate in 2002				
90% or More			76 %	72 %
89% or Less			24 %	28 %
Counselor-student Log Ratio in 2002	3.42	3.42		
School Social System Variables				
General Positive Climate in 2002	-0.01	0.01		
Environmental Incivility in 2002	0.07	-0.16		
School Safety in 2002	0.06	-0.16		
School Culture Variables				
Academic Press in 2002	0.01	-0.09		

Table 8

Zero-order Correlation Coefficients among Level-1 Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. European American	—												
2. Latino/a American	—	—											
3. African American	—	—	—										
4. Asian American	—	—	—	—									
5. Multiracial	—	—	—	—	—								
6. Native American	—	—	—	—	—	—							
7. Male	.01	-.02	-.00	.00	.01	.02	—						
8. Family SES in 2002	.29 ***	-.27 ***	-.13 ***	.01	-.00	-.02	.03 *	—					
9. 10th-grade Math Ach. in 2002	.34 ***	-.21 ***	-.27 ***	.07 ***	-.02	-.05 ***	.06 ***	.40 ***	—				
10. Highest Math Course Taken in 2004	.09 ***	-.11 ***	-.03 *	.07 ***	-.02 *	-.06 ***	-.05 ***	.27 ***	.50 ***	—			
11. Student's Ed. Aspiration	.05 ***	-.07 ***	.00	.02	.01	-.02	-.10 ***	.17 ***	.24 ***	.24 ***	—		
12. Parental Ed. Expectation	.04 ***	-.04 **	-.03 *	.02	-.01	-.01	-.03 *	.16 ***	.16 ***	.12 ***	.18 ***	—	
13. Peers' Ed .Aspiration	-.09 ***	.03 **	.09 ***	.03 *	-.02	-.00	-.16 ***	-.00	-.03 *	.06 ***	.10 ***	.03 *	—
14. Math Ach. in 2004	.31 ***	-.20 ***	-.25 ***	.08 ***	-.01	-.05 ***	.07 ***	.42 ***	.90 ***	.56 ***	.24 ***	.15 ***	-.03 *

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 9

Multicollinearity Diagnostics for Level-1 Variables

	Tolerance	VIF	Condition Index
Constant			1.00
Latino/a American	.83	1.20	2.23
African American	.82	1.22	2.47
Asian American/Pacific Islander	.97	1.03	2.47
Multiracial	.97	1.03	2.48
Native American	.99	1.02	2.59
Male	.96	1.05	3.11
Family SES in 2002	.78	1.29	3.57
10th-grade Math Achievement in 2002	.59	1.74	3.96
Highest Math Course Taken in 12th-grade in 2004	.70	1.43	7.40
Student's Educational Aspiration in 2002	.89	1.13	11.17
Parental Educational Expectation in 2002	.95	1.06	14.34
Peers' Educational Aspiration in 2002	.95	1.05	21.15

Table 10

Level-1 Variables and Math Achievement at 12th-grade in 2004

	0	1	2	3	4	5	6	7	
Fixed Effect	*Coefficient*	*Coefficient*	*Coefficient*	*Coefficient*	*Coefficient*	*Coefficient*	*Coefficient*	*Coefficient*	*SE*
Average 12th-grade Math Achievement in 2004, γ_{00}	.01	.02	.03 **	.04 ***	.04 ***	.04 ***	.04 ***	.04 ***	.01
Latino/a American, γ_{10}		-.34 ***	.05	.02	.02	.02	.01	.03	.03
African American, γ_{20}		-.66 ***	-.02	-.07 ***	-.07 ***	-.07 ***	-.08 ***	-.07 ***	.02
Asian American/Pacific Islander, γ_{30}		.14	.10 **	.06	.06	.06	.05	.03	.03
Multiracial, γ_{40}		-.24 **	.02	.02	.02	.02	.02	.02	.04
Native American, γ_{50}		-.61 ***	.02	.05	.05	.05	.04	.05	.10
Family SES in 2002, γ_{60}		.43 ***	.08 ***	.06 ***	.06 ***	.05 ***	.05 ***	.05 ***	.01
10th-grade Math Achievement in 2002, γ_{70}			.07 ***	.07 ***	.07 ***	.07 ***	.06 ***	.07 ***	.00
Highest Math Course Taken in 12th-grade in 2004, γ_{80}				.14 ***	.14 ***	.14 ***	.15 ***	.14 ***	.01
Student's Educational Aspiration in 2002, γ_{90}					.01	.00	.02	.02	.02
Parental Educational Expectation in 2002, γ_{100}						.04	.05	.03	.04
Male, γ_{110}							.08 ***	.08 ***	.02
Peers' Educational Aspiration in 2002, γ_{120}								-.03	.02
Random Effect	*Variance Component*	*Variance Component*	*Variance Component*	*Variance Component*	*Variance Component*	*Variance Component*	*Variance Component*	*Variance Component*	
Average 12th-grade Math Achievement in 2004 u_{0j}	.14 ***	.05 ***	.00 ***	.00 ***	.00 ***	.00 ***	.01 ***	.00 ***	
10th-grade Math Achievement in 2002, u_{1j}			.00 ***	.00 ***	.00 ***	.00 ***	.00 ***	.00 ***	
Highest Math Course Taken in 12th-grade in 2004, u_{2j}				.01 ***	.01 ***	.01 ***	.01 ***	.01 ***	
Level-1 Effect, r_{1j}	.78	.69	.19	.16	.16	.16	.16	.15	

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 11

Zero-order Correlation Coefficients among Level-2 Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Small School	___															
2. Medium School	___	___														
3. Large School	___	___	___													
4. Very Large School	___	___	___	___												
5. Noisy Environment	.03	-.02	.00	-.01	___											
6. Insufficient Lighting	-.02	.01	.00	.01	-.02	___										
7. Fully Computerized Campus	-.07	-.09 *	.14 **	.05	-.09 *	.02	___									
8. High Concentration of Minority Students	-.08	-.08	.00	.21 ***	.15 **	.04	-.13 **	___								
9. Average Student SES	-.19 ***	.01	.17 ***	-.03	-.11 *	.05	.19 ***	-.41 ***	___							
10. Average 10th-grade Math Ach. in 2002	-.03	-.03	.08	-.02	-.22 ***	.05	.19 ***	-.47 ***	.72 ***	___						
11. All Full-time Tch. Certified	.05	.10 *	-.10 *	-.07	-.02	.02	-.02	-.23 ***	.18 ***	.20 ***	___					
12. Counselor-student Ratio	.32 ***	-.05	-.12 **	-.15 **	-.02	.02	.04	-.10 *	.08	.10 *	.04	___				
13. General Positive Climate	-.06	.01	-.01	.08	-.08	-.03	.09 *	-.03	.08	.18 ***	.01	-.14 **	___			
14. Environmental Incivility	.13 **	.06	-.11 **	-.08	.03	.05	-.02	.-16 ***	-.06	-.06	.09 *	.00	-.28 ***	___		
15. School Safety	.41 ***	.15 ***	-.31 ***	-.27 ***	-.11 **	.01	.01	-.34 ***	.29 ***	.38 ***	.11 **	.26 **	.22 ***	-.11 **	___	
16. Academic Press	-.07	-.04	.10 *	.01	-.09	.03	.08	-.23 ***	.43 ***	.40 ***	.14 **	.08	.16 **	-.15 **	.23 ***	___
17. Average 12th-grade Math Ach. in 2004	-.07	-.05	.11 **	.01	-.23 ***	.07	.19 ***	-.45 ***	.72 ***	.95 ***	.18 ***	.09	.16 ***	-.07	.34 ***	.41 ***

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 12

Multicollinearity Diagnostics for School Ecology, Milieu, Social System, and Culture Variables

	Tolerance	VIF	Correlations of the Estimated Coefficients			Condition Index
			Medium-size School	Large School	Average 10th-grade Math Achievement	
Constant			.00	.00	.00	1.00
Medium School	.38	2.60	.00	.00	.04	1.31
Large School	.28	3.56	.02	.02	.00	1.84
Very Large School	.48	2.07	.02	.01	.01	1.93
Noisy Environment	.91	1.10	.00	.04	.01	2.12
Insufficient Lighting	.98	1.02	.00	.00	.00	4.60
Fully Computerized Campus	.90	1.11	.00	.00	.00	2.19
High Concentration of Minority Students	.72	1.39	.02	.02	.02	2.59
Average Student SES	.41	2.44	.01	.00	.01	2.66
Average 10th-grade Math Achievement	.39	2.59	.11	.00	.00	2.94
All Full-time Teachers Certified	.89	1.12	.01	.00	.04	2.97
Counselor-student Ratio	.81	1.23	.01	.00	.07	4.11
General Positive Climate	.79	1.27	.00	.00	.80	4.29
Environmental Incivility	.81	1.24	.12	.15	.01	5.12
School Safety	.44	2.28	.52	.59	.00	8.06
Academic Press	.77	1.30	.15	.15	.00	31.28

Table 13

School Climate Variables and Math Achievement at 12th-grade in 2004

	1	2	3	4	5	6	7	8	9	10	11	13	
Fixed Effect	*Coefficient*	*Coefficient*	*Coefficient*	*Coefficient*	*Coefficient*	*Coefficient*	*Coefficient*	*Coefficient*	*Coefficient*	*Coefficient*	*Coefficient*	*Coefficient*	*SE*
Average 12th-grade Math Achievement in 2004, β_0													
Constant, γ_{00}	.03 ***	.04 ***	.03 ***	.04 ***	.03 **	.03 ***	.02	-.00	-.00	.01	.01	.01	.03
Average 10th-grade Math Achievement, γ_{01}	.05 ***	.04 **	.04 **	.04 **	.04 **	.04 *	.04 *	.04 **	.04 **	.04 *	.03 *	.04 *	.01
Average Student SES, γ_{02}		.01	.01	.02	.02	.02	.02	.02	.02	.02	.02	.02	.01
High Concentration of Minority Students, γ_{03}			.00	.00	.00	.00	.01	.01	.01	.01	.01	.01	.02
Academic Press, γ_{04}				-.01	-.01	-.01	-.02	-.02 *	-.02 *	-.02 *	-.02 *	-.02 *	.01
School Safety, γ_{05}					.01	.01	.01	.01	.01	.00	.00	-.00	.01
Noisy Environment, γ_{06}						-.05	-.05	-.04	-.05	-.05	-.05	-.04	.04
Fully Computerized Campus, γ_{07}							.03	.03	.03	.03	.03	.02	.02
High Rate of Certified Full-time Teacher, γ_{08}								.02	.02	.03	.03	.03	.02
General Positive Climate, γ_{09}									.01	.01	.01	.01	.01
Medium School, γ_{010}										-.02	-.02	-.02	.02
Large School, γ_{011}										-.00	.00	-.01	.03
Very Large School, γ_{012}										.01	.01	.01	.03
Counselor-student Ratio, γ_{013}											.01	.01	.02
Environmental Incivility, γ_{014}												-.01	.04
Insufficient Lighting, γ_{015}												.03	.04
10th-grade Math Achievement in 2002, γ_{10}	.07 ***	.07 ***	.07 ***	.07 ***	.07 ***	.07 ***	.07 ***	.07 ***	.07 ***	.07 ***	.07 ***	.07 ***	.00
Highest Math Course Taken in 12th-grade in 2004, γ_{20}	.14 ***	.14 ***	.14 ***	.14 ***	.14 ***	.14 ***	.14 ***	.14 ***	.14 ***	.14 ***	.14 ***	.14 ***	.01
Latino/a American, γ_{30}	.06	.06	.05	.05	.06	.06	.05	.06	.05	.05	.05	.05	.03
African American, γ_{40}	-.06 *	-.06 *	-.06 *	-.06 *	-.05 *	-.05 *	-.05 *	-.05 *	-.05 *	-.05 *	-.05 *	-.05 *	.02
Asian American/Pacific Islander, γ_{50}	.04	.04	.04	.04	.04	.04	.04	.04	.04	.04	.04	.04	.03
Multiracial, γ_{60}	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.04
Native American, γ_{70}	.11	.11	.11	.11	.11	.11	.11	.11	.11	.11	.11	.11	.11
Male, γ_{80}	.08 ***	.08 ***	.08 ***	.08 ***	.08 ***	.08 ***	.08 ***	.08 ***	.08 ***	.08 ***	.08 ***	.08 ***	.02
Family SES in 2002, γ_{90}	.04 **	.03 *	.03 *	.03 *	.03 *	.03 *	.03 *	.03 *	.03 *	.03 *	.03 *	.03 *	.01
Student's Educational Aspiration in 2002, γ_{100}	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.02
Parental Educational Expectation in 2002, γ_{110}	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.03	.04

Peers' Educational Aspiration in 2002, γ_{120}	-.03	-.03	-.03	-.03	-.03	-.03	-.03	-.03	-.03	-.03	-.03	-.03	.02
General Positive Climate, γ_{130}	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	.01
Environmental Incivility, γ_{140}	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	-.01	.01
School Safety, γ_{150}	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	-.02	.01
Random Effect	*Variance Component*	*Variance Component*	*Variance Component*	*Variance Component*	*Variance Component*	*Variance Component*	*Variance Component*	*Variance Component*	*Variance Component*	*Variance Component*	*Variance Component*	*Variance Component*	
Average 12th-grade Math Achievement in 2004 u_{0j}	.00 ***	.00 ***	.00 ***	.00 ***	.00 ***	.00 ***	.00 ***	.00 ***	.00 ***	.00 ***	.00 ***	.00 ***	
10th-grade Math Achievement in 2002, u_{1j}	.00 **	.00 **	.00 **	.00 **	.00 **	.00 **	.00 **	.00 **	.00 **	.00 **	.00 **	.00 **	
Highest Math Course Taken in 12th-grade in 2004, u_{2j}	.01 ***	.01 ***	.01 ***	.01 ***	.01 ***	.01 ***	.01 ***	.01 ***	.01 ***	.01 ***	.01 ***	.01 ***	
Level-1 Effect, r_{1j}	.15	.15	.15	.15	.15	.15	.15	.15	.15	.15	.15	.15	

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 14

School Climate Variables and the 10th-grade to 12th-grade Achievement Slope

Fixed Effect	*Coefficient*	*SE*
10th-grade Math Achievement in 2002, β_1		
Constant, γ_{10}	.07 ***	.00
Medium School, γ_{110}	-.00	.00
Large School, γ_{111}	-.00	.00
Very Large School, γ_{112}	-.00	.00
Noisy Environment, γ_{16}	-.01	.01
Insufficient Lighting, γ_{115}	-.00	.00
Fully Computerized Campus, γ_{17}	-.00 *	.00
High Concentration of Minority Students, γ_{13}	-.00	.00
Average Student SES, γ_{12}	.00 *	.00
Average 10th-grade Math Achievement, γ_{11}	-.00	.00
High Rate of Certified Full-time Teacher, γ_{18}	-.00	.00
Counselor-student Ratio, γ_{113}	.00	.00
General Positive Climate, γ_{19}	.00	.00
Environmental Incivility, γ_{114}	-.00	.00
School Safety, γ_{15}	-.00	.00
Academic Press, γ_{14}	-.00	.00

Table 15

School Climate variables and the Highest-level-of-mathematics-course-taken to Achievement Slope

Fixed Effect	*Coefficient*	*SE*
Highest Math Course Taken in 12th-grade in 2004, β_2		
Constant, γ_{20}	.13 ***	.03
Medium School, γ_{210}	.02	.02
Large School, γ_{211}	.05	.03
Very Large School, γ_{212}	.06	.05
Noisy Environment, γ_{26}	.04	.05
Insufficient Lighting, γ_{215}	.06	.08
Fully Computerized Campus, γ_{27}	.01	.02
High Concentration of Minority Students, γ_{23}	-.04	.03
Average Student SES, γ_{22}	-.03 *	.02
Average 10th-grade Math Achievement, γ_{21}	.04 *	.02
High Rate of Certified Full-time Teacher, γ_{28}	-.01	.03
Counselor-student Ratio, γ_{213}	.00	.03
General Positive Climate, γ_{29}	-.00	.01
Environmental Incivility, γ_{214}	-.01	.01
School Safety, γ_{25}	.01	.01

Appendix A

Twenty-seven student-reported items regarding school policy, school safety, teacher behavior, student-teacher relationship, civility among student groups, and student behavior were selected to create the composite measures. Principle axis factoring was used to investigate the underlying construct of these items and items with low loading (i.e., less than .4) or high cross-loading (i.e., larger than .4) were dropped from the analyses. Based on the results of scree test and interpretability of the factor solution, three factors were rotated using a Varimax rotation procedure. Table Appendix-1 displays rotated factor loading coefficients, Eigenvalues, and percentage of variance explained of the three factors. Each factor was named by the term that can represent its underlying construct. The first one was termed as “general positive climate,” accounting for 15.4% of the common variance after Varimax rotation; the second was called “environmental incivility,” accounting for another 15.1% of the common variance; and the third was named as “school safety,” accounting for additional 12.7% of the common variance. The three, together, explained 43.2% of the variance.

The composite measures were created based on items in the three identified factors as well as factor loadings of each item. The General Positive Climate scale consisted of item 1 to 6; the Environmental Incivility scale was composed of item 7 to 12; and the School Safety scale was composed of item 13 to 16. Some items were recoded in a reverse direction. For every student, factor scores of the three composite scales were computed based on factor loadings of each item. Individual factor scores were then aggregated into school level and transformed into *z*-scores for further analysis.

Table A1

Rotated Factor Loadings, Eigenvalues, and Percentage of Variance Accounted for of the Selected Items (N=579)

	Factor 1 General Positive Climate	Factor 2 Environmental Incivility	Factor 3 School Safety
1. Teachers are interested in students	.76	.15	.15
2. The teaching is good	.68	.16	.21
3. Teachers praise effort	.62	.17	-.06
4. School rules are fair	.60	-.03	.19
5. Punishment same no matter who you are	.54	.22	-.07
6. There is real school spirit	.42	-.00	.30
7. Someone bullied or picked on 10th grader	.01	.71	-.14
8. Someone threatened to hurt 10th grader at school	.13	.69	.13
9. Someone hit 10th grader	.14	.63	.04
10. Someone damaged belongings	.11	.62	.07
11. In class often feels put down by students	.13	.49	.11
12. Someone forced money/things from 10th grader	.06	.45	.20
13. There are gangs in school	.01	-.04	.84
14. Racial/ethnic groups often fight	.02	.08	.66
15. Does not feel safe at this school	.35	.23	.63
16. Disruptions get in way of learning	.15	.13	.47
Eigenvalue [a]	2.5	2.4	2.0
% of Variance Explained [a]	15.4	15.1	12.7

[a] The values represented the distribution of the variance after the Varimax rotation.

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