STUDENT PERCEPTIONS OF SCHOOL CULTURE AND ACHIEVEMENT: TESTING THE INVARIANCE OF A MODEL

George A. Marcoulides, California State University at Fullerton, USA
Ronald H. Heck, University of Hawaii at Manoa, Hawaii
Constantinos Papanastasiou, University of Cyprus, Cyprus

Abstract

This study examines the generalizability of a previously validated model on how student perceptions of the school culture affects student achievement. Third International Mathematics and Science Study (TIMSS) data were collected from 1026 eighth-grade students in secondary schools in Cyprus. The results indicated that achievement scores can be explained by student perceptions of the school cultural environment. The theoretical and practical implications of the results are discussed.

INTRODUCTION

Studies on school effectiveness have identified a number of important factors that can affect student achievement (e.g., Heck & Marcoulides, 1996; Lee & Croninger, 1994; Mortimore, 1991, 1993; Reynolds & Packer, 1992). In addition to student background and contextual influences, researchers have identified certain factors in secondary schools that can influence students' learning opportunities. These factors refer to the school's structural and organizational processes (e.g., size, course offerings, class formation procedures, grouping practices), resource allocations (teacher course assignment, funding particular programs), its academic focus (e.g., curriculum alignment and delivery, expectations of students, educational experiences, monitoring student progress) and social integration (e.g., how students interact with peers, teachers). Decisions on how schools are organized and operate, how resources are allocated, how classrooms are formed, and how students are taught, all impact on student learning. How well the school staff are able to organize and coordinate the work life of the school shapes not only the learning experiences and achievements of students, but also the environment in which this work is carried out (Heck, Larsen, & Marcoulides, 1990).

More recent studies have emphasized students' academic and social integration, as

this can be affected by the sociocurricular structure of the school (Friedkin & Thomas, 1997). For example, parent and student beliefs and values related to course selection, student participation the school's educational program, students' attitudes toward learning, student interactions with peers and teachers, and the school's overall academic climate, are influenced by the school's structure. Students' academic and social experiences, therefore, can be viewed as a sequence of encounters with various course offerings, teachers, and other students. The differentiated curriculum typically offered in secondary schools can also influence students' educational and social experiences in important ways. In general, students' experiences in relation to these school processes can all be seen as elements in a conceptual framework that suggests the importance of a school's cultural processes (i.e., its climate, values, and educational experiences) in determining students' educational outcomes.

Despite the vast literature on school effectiveness, there is little consensus on how these processes intersect and affect outcomes. Defining and measuring these types of variables is important in that school personnel have considerable control over the school's processes-in sharp contrast to their lack of control over student and community characteristics. Variables related to student perceptions of their learning environment can provide helpful information on the quality of their educational experiences (e.g., academic press, learning opportunities) and can help explain why student achievement varies across classrooms and schools. Although student, staff, and parent information on classroom and school processes are a valuable and cost-effective source of information on schools' academic processes, it can be difficult to obtain sufficiently reliable and valid information with which to formulate indicators of these processes. Despite some of these challenges, individuals' perceptions of school learning processes are important indicators of their experiences within the organizational structure of schools (Heck et al., 1990; Heck & Marcoulides, 1996).

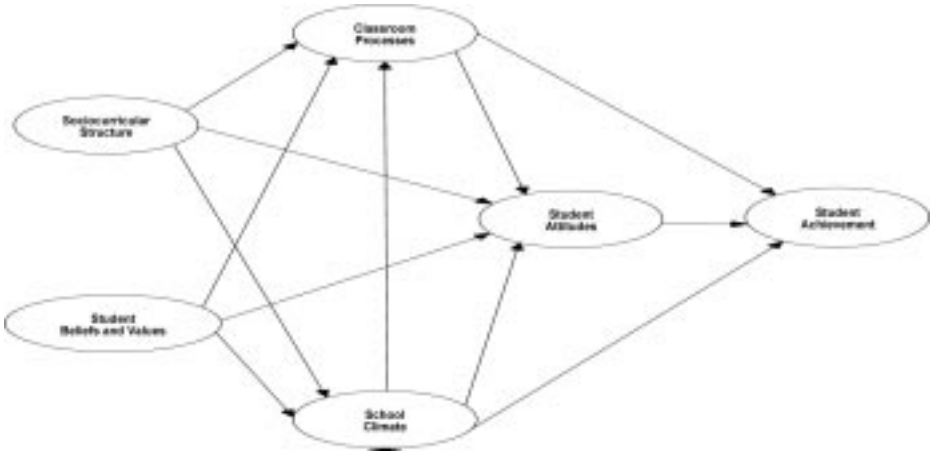
In a 1996 study, we (Heck and Marcoulides) attempted to synthesize and reported school factors using a model we had developed earlier (1993a) to examine productivity in product and service organizations. We had originally proposed and tested a model of some important perceptional aspects of organizational culture that can make a difference in productivity. We hypothesized that organizational culture consists of three interrelated dimensions: a sociocultural system of the perceived functioning of the organization's tasks, strategies, and practices; an organizational value system; and the collective beliefs and attitudes of the individuals working within the organization (Allaire & Firsirotu, 1984; Schein, 1990). Taken together, these three dimensions were found to affect performance in a variety of product- and service-oriented organizations. We subsequently examined the generalizability of the organizational model to an educational environment, and determined that visible aspects of organizational culture can affect student performance (Heck & Marcoulides, 1996).

The purpose of the present study is to test whether this type of model can interpret the relationship (if any) between the measurable aspects of schools' academic and social processes and student achievement, using data from the Third International Mathematics and Science Study (TIMSS). There are obviously many indicators of

school internal conditions and instructional processes, and we emphasize that it would be a mistake to think of any set of indicators as complete. In similar studies, however, we have found that these types of process indicators contribute to explaining student outcomes in a number of different settings, and with data from different instrumentation and respondents (i.e., students, teachers, principals) (e.g., Heck et a. 1990; Heck & Marcoulides, 1996). In the present study, we focus on student perceptions, beliefs, and values to operationalize the various constructs in our proposed model. We chose to analyze the model at the individual student level, since previous research has revealed that students' perceptions and experiences with the school's educational and social processes vary primarily within schools.

Figure 1 presents the model originally proposed by Heck and Marcoulides (1996). (For detailed explanation of each variable see the Methods section). The model specifies five factors that together comprise visible aspects of school culture that, in concert, influence student achievement. In this specific case, student achievement is measured on a standardized test of math. As a group, the factors are viewed as loosely comprising students' perceptions of the three subsystems of school culture (i.e., sociocultural, organizational process, and individual belief) proposed by Allaire and Firsirotu (1984) and empirically tested by Marcoulides and Heck (1993a) and Heck and Marcoulides (1996). The first component is a sociocultural subsystem composed of perceptions about organizational structures (e.g., sociocurricular structure, course offerings, student groupings). The second component is an organizational process and values dimension (e.g., beliefs and values of the school about classroom instructional processes, beliefs about school climate and social relations). A final component is the individuals' attitudes and views.

Figure 1: Hypothetical initial factor model



Sociocultural factors. In this study, sociocultural factors are defined by students' perceptions of their social capital (e.g., parent education, books and educational

materials in the home) and their beliefs about grouping practices. These two constructs are represented as exogenous variables, in that factors outside the model determine their variability. These types of variables are proxies that actually represent dynamic processes about the extent to which students perceive their placement within the school's social and curricular structure. For example, Friedkin and Thomas (1997) found a variety of different social positions within schools using a large, nationally representative data base of schools in the United States. Similarly, Price (2001) determined that the school's sociocurricular structure (which represented students' socioeconomic backgound, ethnicity, gender, and previous academic achievement) had a profound impact on students' academic achievement and postsecondary aspirations. We reasoned that the students' perceptions of their social capital and values regarding grouping practices would be reflective of more general sets of variables that detail the school's sociocurricular structure. These variables should affect students' perceptions of classroom processes and their individual attitudes about learning math.

Organizational processes. Students' perceptions of climate and teaching processes are defined as endogenous in that other variables in the model determine their variability. The exogenous variables, therefore, are hypothesized to affect student achievement indirectly through the various endogenous variables in the model. For example, we expect that students' values about grouping practices will least partially explain students' attitudes, because individual students from an early age are socialized into the educational environment.

Individual beliefs and attitudes. This last component is defined by students' beliefs and attitudes about learning mathematics.

METHOD

Subjects

Cyprus is the third largest and most populated Mediterranean island after Sicilia and Sardinia. Its total population is around 750,000, which places it firmly in the small country category (Wilson, 1992). It is one of the two most recent countries in the Mediterranean to join the European Union and is the closest European country to the oil-producing countries of the Arab Gulf. As a consequence, it has become a very attractive investment location for many multinational companies. In addition to sizeable increases in direct investment, many American companies are establishing joint and mixed ventures as well as engaging in licensing and franchising agreements.

Complete data were collected from 2923 Greek-speaking secondary-school students in all 55 gymnasia (secondary schools) on the island of Cyprus (about 31% of the entire population). Background data on the students who participated in the study are as follows: Age: 13.7 ; Gender: Female 48.8%; male 51.2%; Origin: Urban 67%; rural 33%. Because of the island's size, major differences in socioeconomic status that are often observed in U.S. studies are not as marked in this data set. In addition, secondary schools in Cyprus tend to be highly centralized and examination-oriented.

Instrumentation

The Third International Mathematics and Science Study (TIMSS) sponsored by the International Association for the Evaluation of Educational Achievement (IEA), had as its stated aim the measurement of student achievement in Mathematics and Science and the assessment of certain factors influencing student learning in theses subjects (Papanastasiou, 2002). Since its accession to IEA membership, Cyprus has been a regular participant in the IEA research projects. The instruments used in the study include the written tests of Mathematics and a background questionnaire focusing on the contexts for student learning in the subject (Martin & Kelly, 1995). Students' knowledge and understanding of mathematics is assessed through a range of multiple-choice and constructed-response question formats. The background questionnaire investigates aspects of students' home and school lives, including classroom experiences, self-perception and attitudes about mathematics, homework and out-of-school activities, home educational supports, and basic demographic information. The assessment time for each achievement test is approximately 90 minutes and the background questionnaire requires 15-30 minutes to complete.

Variables Included in the Model

In testing the proposed model, only those observed variables that were identified conceptually with the various constructs in our model were used. Table 1 provides summary information about the variables used, grouped according to the constructs they measure. A complete description of these variables, grouped according to the latent variables they are posited to measure, follows.

Sociocurricular Structure: This construct reflects students' educational background and social capital. As conceptualized in this study, this construct serves as a type of proxy for students' social position within the school's sociocurricular structure. We hypothesized that students with higher social capital (e.g., parent levels of education, educational technology in the home) will perceive classroom processes more favorably, have more positive attitudes about learning math, and because of these relationships, will perform better in mathematics.

Student Beliefs and Values: This construct describes student beliefs and values on the influence of sociocurricular positioning in relation to student learning. It is measured by items associated with students' perceptions of the importance of being placed in classes with high achieving students and their general beliefs about what is needed to be successful in learning mathematics (e.g., working hard, being prepared).

Classroom Processes: This construct represents students' perceptions of strategies and practices teachers use to help students learn. The construct is measured by items relating to the extent to which students work on projects in class, discuss practical problems, and work on problems related to everyday life. It also asks their perceptions of teachers' follow-through on checking homework assignments, discussing homework assignments, and presenting aligned curricular and assessment practices.

Table 1: Factors, Items, Item Means, SD, and Factor Loadings

Factors	*Items*	*Loading*	$\bar{X}$	*s.d.*
Sociocurricular structure	Highest education level-mother	.87	4.76	3.46
	Highest education level-father	.87	5.11	3.41
	Number of books in student home	.55	3.49	1.50
	Home possess- calculator	.69	1.12	0.80
	Home possess -dictionary	.69	1.11	0.79
Student beliefs-values	Mother thinks it is important to be -placed with high achieving students	.76	2.45	1.87
	Friends think it is important to be -placed with high achieving students	.79	2.51	1.59
	I think it is important to be placed -with high achieving students	.82	2.38	1.69
Classroom processes	Work on projects	.57	3.03	1.44
	Problems related to everyday life	.57	2.65	1.47
	Teacher checks homework	.60	2.16	1.55
	Discuss completed homework	.63	2.16	1.49
	Discuss practical problems	.52	2.41	1.49
	Teacher asks what student knows	.53	2.41	1.55
	To do well in mathematics you need hard work	.86	1.60	1.31
Climate	Student thought he might get hurt	.63	1.83	1.46
	Friends skipped a class	.61	2.65	1.56
	Friend had something stolen	.75	2.02	1.44
	Friend thought might get hurt	.65	2.39	1.40
Student attitudes	I like mathematics	.86	3.02	1.33
	I enjoy learning mathematics	-.83	2.07	1.48
	Mathematics is not boring	.72	3.13	1.55
	Mathematics is an easy subject	-.69	2.91	1.64

Climate: This construct is described by students' perceptions about a variety of school conditions including personal and peer safety, student attendance patterns, and the presence of theft in the classroom.

Student Attitudes About Math: This construct reflects students' attitudes about learning math. It is measured by the extent to which students enjoy the subject

mathematics, enjoy learning mathematics, and feel they have an aptitude for learning mathematics.

Student Performance: Student performance reflects the student's level of academic performance on the Mathematics portion of the Third International Mathematics and Science Study (TIMSS Assessement Design, 1995).

RESULTS

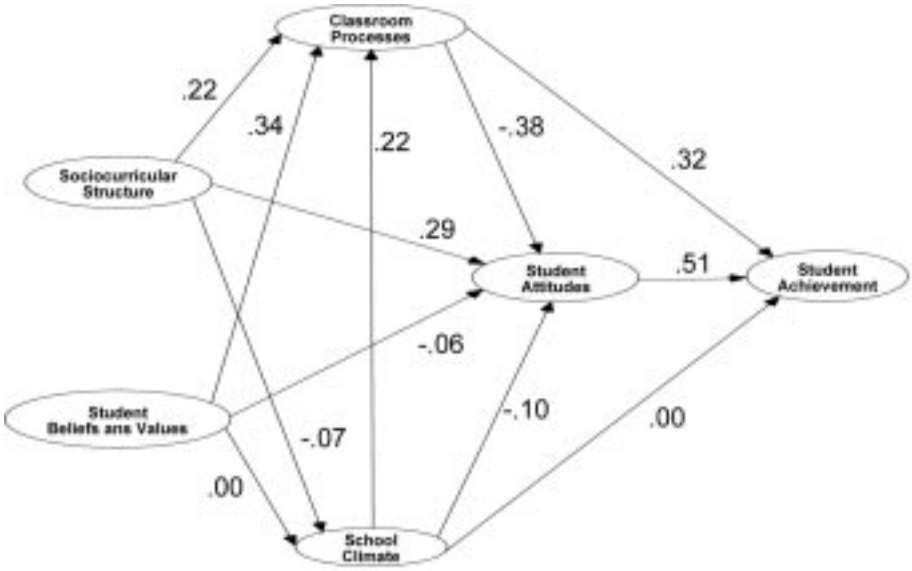
The proposed model was tested using LISREL 8.54 (Joreskog and Sorbom, 1993). Since we posited an *a priori* defined model to be tested, our first interest lies in determining model fit. Once model fit is determined, the significance of the various parameter estimates can be ascertained. Several indices can be used to determine the fit of the data to the model. These include the goodness of fit index (GFI), the root mean square error of approximation (RMSEA) and its 90% confidence interval, the Akaike Information Criterion (AIC), and the chi-square to degrees of freedom ratio (x^2 /df), although it is well known that with large sample sizes, such as that used in this study, the size of the x^2 coefficient has a tendency to reject models, even if they are only marginally inconsistent with the data (Raykov & Marcoulides, 2000).

Table 2: Measures of Model Fit

Chi-Square/Degrees of Freedom (84.45/45)	1.88
Goodness of Fit Index (GFI)	0.95
Model AIC	1207.07
Independence AIC	3312.22
Saturated AIC	2578.36
Root Mean Square Error of Approxiation (RMSEA)	0.04
90% Confidence Interval for RMSEA	(0.02 ; 0.04)

Table 2 presents the fit indices obtained for the proposed model, all of which indicate good model fit to the data. It is generally recognized that GFI values of 0.95 indicate a satisfactory model fit. On the other hand, an RMSEA value of less than .05 and a not-too-wide internal are considered to indicate that the model is a plausible means of describing the data. The AIC is a special kind of fit index that takes into account both model fit and model complexity. Generally, proposed models with low AIC values (especially relative to the saturated model) are more likely to better describe data than models with higher AIC indices (Raykov & Marcoulides, 2000). Finally, a chi-square to degrees of freedom ratio below 2 generally indicates a reasonable fit of the model.

Figure 2: Standardized LISREL parameter estimates of proposed model.



Because the model was determined to fit the data reasonably well, we can now assess more thoroughly the significance of the empirical validation of the proposed model. Figure 2 presents the LISREL parameter estimates of the model tested. These parameter estimates are indices that represent the simultaneous contribution of each observed and latent variable to the overall model. Overall, the set of latent variables in the model accounted for 25 percent of the variance in student achievement.

The standardized path diagrams in the figure summarize a number of relevant findings on how students perceive aspects of school culture in relation to school outcomes. First, the strongest direct effect on student outcomes in the present study was shown to be student attitudes about learning math (.51). More positive attitudes about learning mathematics were associated with higher student achievement. The results further indicate that student attitudes were partially explained by student sociocurricular background in the school (.29); that is, students with stronger sociocurricular positioning (i.e., higher parent education, more educationally related items in the home) had more positive attitudes about learning mathematics. Classroom teaching processes, however, were negatively related to student attitudes about learning mathematics (-.38). More specifically, the types of instructional activities students reported that teachers used in the classroom (i.e., focusing primarily on problems related to everyday life, checking and discussing homework) were negatively related to students' attitudes about math. This may suggest that some types of classroom processes that students perceive as "routine" (e.g., reviewing homework, working on everyday problems) may actually diminish students' positive attitude for learning the subject.

Second, the effects of climate on student learning were nonexistent (.00). This

finding suggests that students' perceptions of safety, attendance, and behavior have little to do with their learning attitudes and their performance in math, other things being equal. Third, student beliefs and values affected perceptions of teaching processes positively (.34), but were not related to perceptions about climate or student attitudes about learning math.

Fourth, student perceptions of teaching processes affected perceptions of organizational climate weakly (.22). Moreover, we observed a weak direct effect of perceptions of sociocurricular structure on teaching processes (.22). More specifically, students with higher social capital viewed their teachers' instructional practices in more positive terms. We also observed a positive total effect of sociocurricular structure on student outcomes (.18) through combined paths in the model.

Finally, the direct effects of students' perceptions of teaching practices were positively related to student outcomes (.32) in this data set. The total effect of this variable, however, was smaller (.11) because of the negative indirect effect of classroom processes on outcomes (-.21) through student attitudes.

DISCUSSION

In this article we proposed a model summarizing several variables thought to represent aspects of organizational culture and their effects on performance. We were interested in determining whether the model Marcoulides and Heck (1993) previously tested with a variety of product and service organizations could describe relationships in data collected within secondary schools. Our purpose was to identify variables in the school's cultural environment that contribute to student performance, because policymakers, administrators, or others promoting school improvement may be interested in their effect on learning/achievement. As Fullan (1991) argued, school improvement is an organizational process, with all this ideal entails both within the school and in relation to the external environment. Serious reform involves changing the culture and structure of the school (e.g., Fullan, 1991; Sarason, 1982). We offer several conclusions and implications from the study in this final section.

Similarity of Models Tested

Most importantly, our model tested in secondary schools compares quite favorably with previous tests of organizational culture and performance conducted in a variety of profit and service organizations (Marcoulides & Heck, 1993a) and in secondary schools in Singapore (Heck & Marcoulides, 1996), although the specific parameter estimates (and error terms) between the constructs in each model are somewhat different. When conducting tests of model invariance, it is probably best not to put too much weight on this latter part of the findings, however, because of the potential effects of different sample sizes, subjects, and instruments used to collect the data (Marcoulides & Heck, 1993b).

First, in broad terms the models were found to be comparable; that is, the models were similar in terms of the number of latent constructs, general direction of paths,

and overall goodness-of-fit indices. The congruence of the models in different organizational settings and with different types of subjects (e.g., teachers, students) tends to add to the model's construct validity. Moreover, this suggests that the relative impact of at least some aspects of a school's culture (e.g., sociocurricular structure, instructional processes, values and attitudes of students about their educational experiences) are predictive on a variety of valued outcomes (accounting for 25% of the variance in student scores). Moreover, despite differences in sample sizes and instrumentation, our latent constructs (i.e., sociocurricular structure, values, teaching processes, and climate) all revealed similar direct effects on outcomes.

Second, in all of the models, individual attitudes were the strongest predictors of outcomes. Third, student perceptions of what teachers do in classrooms (i.e., focus on real life problems, discuss and hold students accountable for homework) were positively related to their math performance over time, although negatively related to their attitudes about learning math. Fourth, student beliefs and values about being placed in classes with peers who are high achieving were positively related to classrooms where students perceived that certain types of teaching took place more regularly. Fifth, consistent with previous research (Friedkin & Thomas, 1997; Price, 2001), we determined that students' socioeconomic positioning within the sociocurricular structure of the school (i.e., as a measure of their social capital) positively affected their perceptions of classroom processes and their attitudes about learning math-that is, students' who reported having more social capital in the home reported on classroom processes more positively and held more positive attitudes about learning math. This reinforced their achievement.

Major differences in the model as tested in product or service organizations and secondary schools were that in the latter cases individual perceptions (i.e., teachers, students) of school climate did not contribute directly (i.e., in a statistically significant manner) to student outcomes.

Implications

Overall, our findings provide glimpses on how cultural processes within schools may contribute to student outcomes. Of course, some of this influence is direct, and smaller amounts were found to be indirect. This has implications, however, for strategies to improve schools. This study confirms what some previous studies have indicated (e.g., Heck et al., 1990; Leithwood et al., 1993; Snyder & Ebmeier, 1992), that is, that there are a number of in-school processes, loosely constituting an organization's culture, that contribute to achievement outcomes. These include students' socioeconomic backgrounds, values, classroom structures (Barr & Dreeban, 1983), resource allocations (Bossert, 1988) teaching practices (Teddlie et al., 1991), and student attitudes about learning.

While school leaders' control over these domains is certainly not absolute, we believe that relative to some other variables associated with the school's environment (e.g., socioeconomic status of the community, student language background, student intake variables), organizational culture represents a number of in-school processes that leaders can influence more readily (e.g., sociocurricular

groupings, personnel allocations, teacher instruction). In contrast to the effective schools model of principal leadership of the 1980s (emphasizing strong instructional leadership), the complexity of political, cultural, and human elements in school settings today requires a type of leadership that is more focused on organizational improvement (e.g., Leithwood, 1992), in that it seeks to build commitment to vision and purpose through building collegial social relations. In this case, it suggests that a number of within-school variables (e.g., grouping practices, classroom teaching strategies, and student attitudes) that are related to student achievement.

Overall, the results of our various model tests suggest that leaders may be able to utilize the concept of organizational culture to help solve specific organizational problems (Tierney, 1988). As Tierney suggested, and our results support, an organization's culture is reflected in what is done, how it is done, and who is involved in these processes. Determination of the particular profile of organizational culture present in an organization may provide information on options that are available in managing, or changing, the determinant variables. By investigating the variables identified in this study further, it may be possible to explain why some students (or schools) are not performing at desired levels. We suggest further longitudinal studies to understand more completely how organizational culture develops over time within organizations. The concepts presented in this research study represent an initial attempt to describe quantitatively various aspects of culture identified in previous theory and research on organizations. Expanding on this rudimentary beginning might be a profitable goal for future research.

References

Allaire, Y. and Firsirotu, M.E. (1984). Theories of *Organizational Culture. Organizational Studies, 5* (3), pp. 193-226.

Barr, R. & Dreeban, R. (1983). *How schools work*. Chicago: University of Chicago Press.

Bossert, S. (1988). School effects. In N. Boyan (Ed.) *The Handbook of Research on Educational Administration*. New York: Longman.

Friedkin, N. & Thomas, S. L. (1997). *Social positions in schooling. Sociology of Education, 70*, 239-255.

Fullan, M. (1991). *The new meaning of educational change*. New York: Teachers College, Columbia University.

Heck, R.H., Larsen, T.J., and Marcoulides, G.A. (1990). Instructional Leadership and School Achievement: Validation of a Causal Model. *Educational Administration Quarterly, 25* (2), pp. 94-125.

Heck, R. & Marcoulides, G. (1996). School culture and performance: Testing the invariance of an organizational model. *School Effectiveness and School Improvement, 7*(1), 76-95.

Joreskog, K.G., and Sorbom, D. (1993). *LISREL VIII*. Chicago, IL: Scientific Software.

Leithwood, K. (1992). The move toward transformational leadership. *Educational Leadership*, 49(5), 8-12.

Leithwood, K., Jantzi, D., Silins, H., & Dart, B. (1993). Using the appraisal of school leaders as an instrument of restructuring. *Peabody Journal of Education, 68*(2), 85-109.

Lee, V. E. & Croninger, R. G. (1994). The relative importance of home and school in the development of literacy skills for middle-grade students. *American Journal of Education, 102*(3), 286-329.

Marcoulides, G. & Heck, R. (1993a). Organizational culture and performance: Proposing and testing a model. *Organization Science, 4*(2), 209-225.

Marcoulides, G. & Heck, R. (1993b). Examining administrative leadership behavior: A comparison of principals and assistant principals. *Journal of Personnel Evaluation in Education, 7*(1), 81-94.

Mortimore, P. (1991). The nature and findings of research on school effectiveness in the primary sector. In S. Riddell and S. Brown (Eds.) *School effectiveness research: Its messages for school improvement.* Edinburgh: HMSO.

Mortimore, P. (1993). School effectiveness and the management of effective learning and teaching. *School Effectiveness and School Improvement*, 4(4), 290-310.

Martin, M. O., Kelly, D. L. (1996). TIMSS Technical Report (Vol. 1). Chestnut Hill, MA: Boston College.

Papanastasiou, C. (2002). Effects of background and school factors on the mathematics achievement. *Educational Research and Evaluation: An international Journal on Theory and Practice, 8*(1) 55-70.

Price, C. L. (2001). *Tracks as emergent structures: A network analysis of student differentiation in a high school.* Unpublished doctoral dissertation. University of Hawaii at Manoa.

Reynolds, D. & Packer, A. (1992). School effectiveness and school improvement in the 1990s. In D. Reynolds and P. Cuttance (Eds.) *School effectiveness: Research, policy, and practice.* London: Cassell.

Raykof T. & Marcoulides G. (2000). A first course in structural equation modeling. Mahwah, NJ: Lawrence Erlbaum.

Sarason, S. (1982). *The culture of the school and the problem of change* (2nd Edition). Boston: Allyn & Bacon.

Schein, E. H. (1990). Organizational Culture. *American Psychologist, 45*(2), pp. 109-119.

Snyder, J. & Ebmeier, H. (1992). Empirical linkages among principal behaviors and intermediate outcomes: Implications for principal evaluation. *Peabody Journal of Education, 68*(1), 75-107.

Tierney, W. (1988). Organizational Culture in Higher Education. *Journal of Higher Education, 59*(1), pp. 2-21.

Wilson, R. (1992). Cyprus and the International Economy. New York, NY: St. Martin's Press.