

CHAPTER 3

AN ECOLOGICAL MODEL OF PHYSICAL, PSYCHOLOGICAL, AND SOCIAL ENVIRONMENTAL FACTORS AFFECTING EDUCATIONAL OUTCOMES⁸

Possible impacts of the physical setting on the quality of education is an important issue which has not been adequately addressed by either the educational or architectural professions. What impact and role does the physical school environment have in affecting learning outcomes? The conclusion from Chapter 2 is that the physical setting, in addition to more familiar psychological and social variables, has both direct and mediated effects on prosocial and achievement outcomes, the conventional bottom-line quantitative measures of educational performance.

Historically, concern for the physical environment of the school has been limited to the enforcement of minimum standards for classroom size, acoustics, lighting and heating--the actual physical conditions of the school building itself. The assumption has been that as long as these basic requirements are met, the child's learning depends in large part on pedagogical, psychological and social variables (Weinstein, 1979). The role of the physical environment as a *variable* influencing learning outcomes has not been investigated extensively in the educational research literature. This second, more dynamic way of viewing buildings, as part of an interrelated component of a larger learning environment system, has rarely been addressed in the research literature.

In order to understand the current debate over the role of the physical setting on learning it is necessary to look at the school reform movements of the 1950s and 1960's; the origins of this debate. The open education movement of the 1960s is largely credited for the increase in awareness of the impact of the physical environment on student behavior and attitudes. Architects designing new schools took a mistakenly too literal interpretation of the *open education* philosophy by creating *open plan* or *open space* schools. The rationale most commonly cited for these radical changes in design was economics, however it is obvious design was being driven by a new philosophy in education.

Much of what is known about the physical environment of the school is a direct result of research conducted under the auspices of the Educational Facilities Laboratories (EFL) established in 1965 and funded by the Ford Foundation. With the dissolution of EFL in the middle 1970s, research on the physical environment of the school has declined considerably.

⁸ An earlier version of this chapter was presented as an unpublished seminar paper by Jeffery A. Lackney entitled "The impact and role of the physical setting of the school on learning outcomes: A case study of the Milwaukee Public Schools Facilities Master Plan," School of Education, University of Wisconsin-Milwaukee, December 1992. For general discussion of interactional models in child-environment research, see Moore (1989). A further explication of the model will be given in a companion paper (in preparation).

The net results of the empirical evidence generated during the open classroom experiments concerning the impact of the physical setting on learning have been mixed. Physical features which have been researched include such variables as seating position, classroom arrangement, open versus traditional classrooms, class density, noise, windowlessness and lighting. Where these features of the physical setting have been examined for causal linkages to student achievement there has been only partial empirical support. However, there is considerable evidence that the physical setting directly effects both teacher and student behavior and attitudes. It can be further argued that the impact of the physical environment on the behavior and attitudes of teachers and students has a mediating effect on student achievement, an effect generally unappreciated by both researchers and educational policy makers.

As reviewed in Chapter 2, there is compelling evidence, such as in the case of class size and school size, that the physical setting impacts directly on academic achievement. Other physical variables such as location and the provision of secluded study spaces impact less directly by effecting blood pressure and student attention spans. These type of variables can be best conceptualized as intervening, or mediating variables (physiological and behavioral, respectively). In terms of explanation, it is not surprising--in the case of location and secluded study space variables--that regular, rather than elevated, blood pressures and increased attention spans will lead to higher achievement outcomes.

These and the other substantive findings reviewed in Chapter 2 suggest the need to develop a more comprehensive model of the factors contributing to learning achievement. The model presented in the chapter reconceptualizes the effects of the physical environment of the school on performance outcomes in light of the more familiar psychological, social and pedagogical factors more often considered by educational researchers.

Making Sense of the Evidence: The Need for an Ecological Model of Physical, Psychological, and Social Environmental Factors Effecting Educational Outcomes

What all of this seems to suggest (direct impacts of environment on behavior, possibilities of mediating effects, etc.) is the need to develop a more comprehensive model of the factors contributing to learning achievement outcomes, including explicit physical environment factors in addition to the more traditional psychological, social and pedagogical factors. Much of the empirical research to date has failed to look comprehensively at the wide range of factors which collectively effect educational outcomes. This lack of direction on the part of the research community has resulted in mixed, contradictory results and has contributed to the decline of interest in this area of research. However, the findings indicate that critical mediating relationships have gone unnoticed, or at least have been ignored in favor of more immediately promising research.

This chapter presents a model of theoretical relationships which attempts to clarify and reconceptualize the empirical research conducted thus far. Such a model would explicitly include not only a range of psycho-social and pedagogical factors, but physical environmental factors as well. Such a mediational-interactive model is proposed in Figure 3.1. This model reconceptualizes the effects of the physical environment of the school on performance outcomes. The mediational-interactive model summarizing theoretical linkages between (a) *independent factors*: physical environment factors (e.g., class size, school size, etc.) and the social-organizational environment (e.g., teaching practices, classroom management); (b) *mediational factors*: behavioral (e.g., student-teacher interaction) and attitudinal (e.g., teacher morale), and physiological (e.g., blood pressure); and (c) *educational outcomes*: achievement (e.g., mathematics achievement scores and Stanford Achievement Test) and prosocial behavioral outcomes (e.g., improved self-concept).

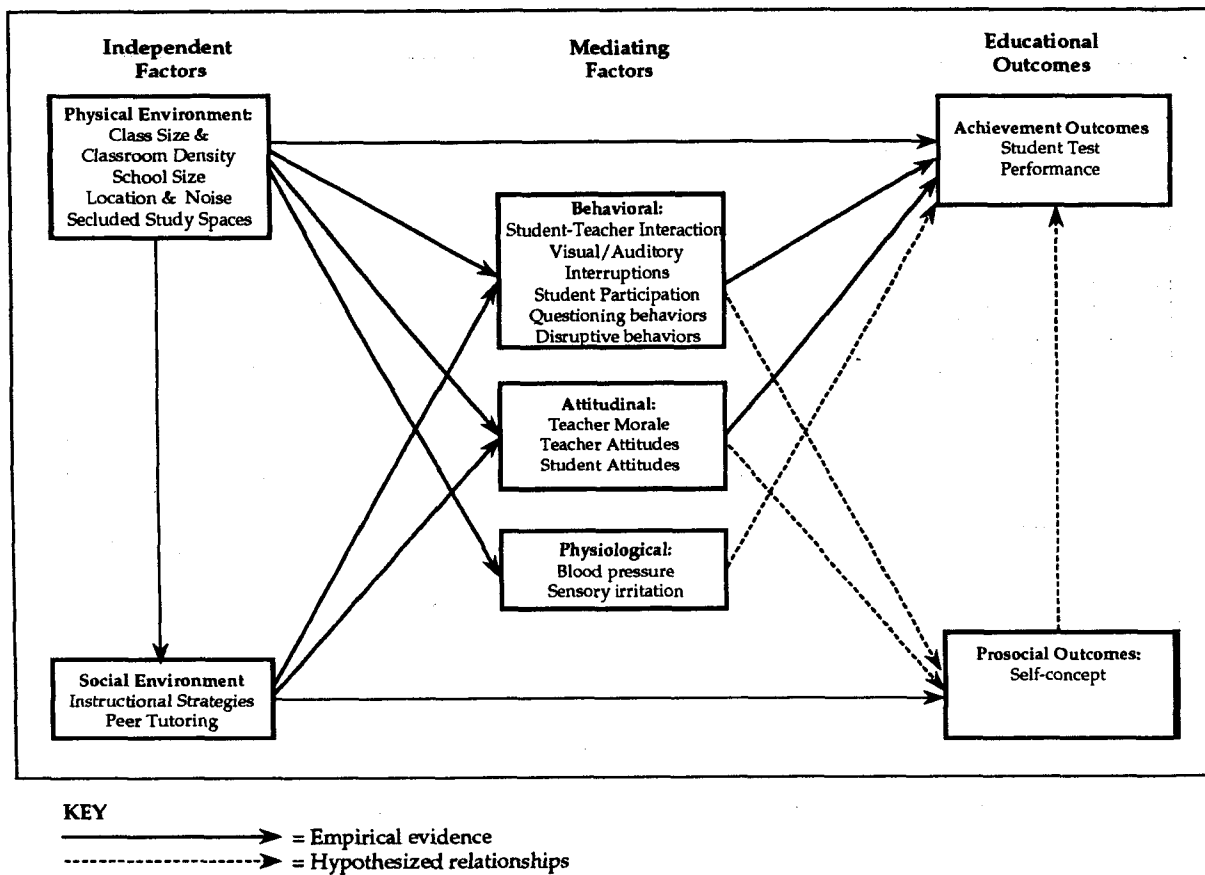


Figure 3.1. A mediational-interactive model of environmental factors affecting educational outcomes.

The data in the educational research literature (e.g., Weinstein, 1979) and reviewed above indicates--and this model summarizes--that physical environmental factors, such as class size and school size, affect academic achievement directly, through mediational factors like influencing teaching practices, and via prosocial outcomes.

The model hypothesizes that as the physical setting of the school improves (e.g., through decreased class sizes and smaller schools), teacher and student behavior and attitudes will improve, and increases in achievement and prosocial outcomes will be further realized. In addition, the model hypothesizes that the physical environment factors affect educational outcomes by affecting teaching practices which impact achievement outcomes through mediating factors, as well as directly affecting prosocial outcomes. In short, the model illustrates both the direct and the indirect/mediated yet consequential effect of the physical environment on achievement outcomes. It may be that with a more comprehensive model, one which includes all potential factors of influence on achievement, the debate over the impact of the physical setting on learning will be clarified and resolved.

The model, shown in Figure 3.1, differentiates between those theoretical relationships which have empirical evidence and those which are as yet hypothesized relationships. The relationships between particular independent factors and specific mediating factors have been firmly established through the weight of the past 30 years of empirical support. The relationships between mediating factors and educational outcomes have not been adequately investigated. Does increased student participation lead to higher student performance? Does improved teacher morale and attitudes lead to an increase in students' self-concepts? These are the types of areas of research educational researchers must focus on if a positive link between physical environmental factors is to be empirically supported.

Additional studies are needed on the impact of educational facility design on performance, and for excellent dissemination of the results in the form of design patterns and in other ways into the educational, facility management, and architectural communities. As a member of the Building Research Board of the National Academy of Sciences, the first of us (GTM) has proposed that the National Academy of Sciences initiate a two-pronged study of educational facilities in the United States. The first prong would be to fully investigate the coast-to-coast magnitude of current problems with the infrastructure of the nation's educational facilities. The second would be to critically review and synthesize the state of knowledge on the impact of school buildings on educational achievement. Those in the educational community concerned with the nation's school buildings need to recommend actions that federal agencies, educational associations, facility managers, and architects and engineers can take to alleviate the problems and provide an appropriate infrastructure for the nation's educational needs for the 21st century.

Conclusions

Even with the weight of empirical evidence presented here and elsewhere (see particularly Fowler, 1992; Garbarino, 1980; Weinstein, 1979), the extent to which the physical environment plays a role in the learning process remains an issue of contention within the educational community. Should school facilities simply continue to be held to minimum standards, or is there a linkage between educational programs and the physical setting which would suggest a more comprehensive approach?

It is clear that the physical environment has been unappreciated for its potentially supportive role in student learning. The relationships between the physical environment, pedagogical, psychological and social factors have yet to be explored to any great extent by educational, child development, or environment-behavior (EB) researchers. If the physical environment is more influential than realized, as suggested by the evidence presented on class size and school size, as well as student and teacher attitudes and behavior, it will be incumbent upon educators to take another look--a more holistic, ecological look--at the whole range of factors and their interrelationships upon which the child's learning depends.

