

# *A Systems Perspective on Effective Schools*

Computer simulation makes it possible for researchers to test the potential effects of alternative school improvement policies.

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Most recent school effectiveness projects have identified a set of discrete indicators of school effectiveness, conducted needs assessments for each individual indicator, and developed a set of separate interventions designed to raise each indicator to some desired level that, it is believed, will produce school effectiveness. The underlying assumption is that a set of independent variables (the indicators of school effectiveness) affect the dependent variables (student outcomes). The emphasis has been on their separate effects. There are difficulties with this approach.

First, although lip-service is paid to the interactions among these indicators of effectiveness, change strategies focus on separate interventions for separate deficiencies. Second, in spite of the work of educational researchers to develop input-output models that assess the relative importance of different variables in influencing student outcomes,<sup>1</sup> improvement strategies tend to assign equal importance to each intervention. Third, the lack of a clear theory about how indicators of school effectiveness *causally* affect student outcomes makes it difficult to determine what the "desired level" of an indicator should be. This theoretical uncertainty also impedes understanding the importance of feedback relationships among student outcomes and future student and teacher behaviors and the nature of system constraints that may severely limit the impact of a given policy.

## **Research Objectives and Method**

In response to these perceived needs, we sought to build a computer simulation model of a school that could demonstrate the essential workings of both effective and ineffective schools and could be used to assess the likely consequences of various school improvement policies.<sup>2</sup> This necessitated formulating a causal theory of a school as an organizational and instructional system. To do this, we went to the research on effective teaching, schooling and to researchers and practitioners who are knowledgeable about school improvement efforts. We took an explicitly theoretical perspective in reviewing the literature in order to extract what appear to be the essential variables and to bring them together systematically in a single conceptual schema.

We decided to limit our work in certain ways. First, we concentrated on reading as the preeminent basic skill. Second, we focused on young children in elementary school because: there has been much research at this level; elementary schools are organizationally less complex than secondary schools; and we would be studying the effects of schooling on children from the very beginning. Finally, we focused on what we call "initially low-achieving children" because in urban schools these children are often poor and minority children and because it is the problem of initially low achievement that is central to the problem of ineffective schooling.

The essential hypothesis we brought to the modeling effort was that schools are systems that produce *multiplier effects* (that is, they reinforce initial patterns of achievement). As a consequence, for children who enter the first grade with a lower level of reading readiness, the less effective school operates in ways that maintain and widen the gap between these students' achievement and grade level standards. We felt certain that there is a critical two-way interaction in schools between achievement and instruction, that this interaction was strongly dependent on teachers' beliefs and expectations as well as on their skills, and that the model we constructed had to incorporate the fundamental dynamics of this interaction.

We chose System Dynamics as a method of modeling and policy analysis for several reasons.<sup>3</sup> First, System Dynamics has an *internal* perspective. It assumes that the problem behaviors arise from the *structure* of the problem system and not as the result of external events. System elements are organized and interrelated in ways that produce the problem behaviors over time.

Second, System Dynamics focuses on feedback structures. Feedback structures<sup>4</sup> are inherent in the idea that system behavior is produced by a set of mutually interdependent and interacting elements. There are no independent variables and dependent variables as in regression analysis. In traditional input-output studies of schooling, student achievement is considered to be the dependent variable and various student and school characteristics are the independent variables. From the System

Dynamics perspective, achievement is a variable that affects and is affected by student characteristics such as behavior, motivation, and the ability to learn new material, and school characteristics such as teacher expectations and teacher emphasis on various achievement groups.

Third, an important characteristic of System Dynamics is the ability to translate one's causal theory about a problem system into a computer simulation model. This enables one to test the internal consistency and robustness of one's theory in a manner that is impossible with mental models. Furthermore, the model allows one to search systematically for important policy levers in the problem system and then to test a range of potential policy solutions for ameliorating the problem. One can evaluate the likely consequences of different policies *before* investing large amounts of time, money, and human resources on a particular policy option in a real school or school district.

The final advantage of System Dynamics lies in the nature of the process. To write a set of mathematical equations for computer simulation, one must be explicit about one's assumptions and the relationships among system variables. The process draws on the existing research literature and on the experiential, qualitative knowledge of practitioners. It encourages dialogue and debate about assumptions and relationships. The process is iterative. Trying to write equations to express a relationship may force one back to the literature for more information or may force one to reconceptualize the relationship completely. It is this circular process of moving between the knowledge base, the theory, and the simulation model that leads to deeper understanding of the problem.

The variables and relationships incorporated in our dynamic theory of schooling described here are based on a careful review of the literature. Additional confidence in the validity of the theory has come from outside review by selected practitioners and scholars and from detailed testing of the simulation model derived from the theory. Empirical research is now needed to test further the choice of variables, the nature of the interactions, and the magnitude of the parameters chosen. In this manner, the

theory and the model become guides for future research.

### A Dynamic Theory of Schooling

The mechanism by which ineffective schools produce different outcomes for different groups of students lies in the feedback relationship between observed achievement and the appropriateness and intensity of instruction delivered to different achievement groups. In the ineffective school, instruction is most intense and appropriate for children whose achievement is already at grade level or above and increasingly less intense and appropriate for children who read further and further below grade level. By contrast, effective schools provide instruction to low-achieving students that is more appropriate and intense in order to bring students' achievement up to grade level.

Current findings make it clear that it is *differing expectations of teachers* for low achieving students that determine patterns of appropriateness and intensity of instruction in effective and ineffective schools.<sup>5</sup> In an effective school, teachers and the principal maintain high expectations for the achievement of all but the clearly exceptional student. They assume that, regardless of family background or social class characteristics, all children can learn at a normal rate and can achieve standard (or better) levels of performance during their schooling. In an ineffective school, expectations for achievement are neither high nor fixed. Children who enter school with a lower level of reading readiness or who are from lower socioeconomic classes are categorized as low achievers (Rist, 1973). It is assumed that there is little the school can do to offset the impact of preschool, family, and environmental conditions.

This feedback relationship involving achievement, expectations, and instruction is the backbone of our dynamic theory of schooling. However, in order to build a simulation model with sufficient detail to test specific school improvement policies, we had to specify more precisely the other variables that also affect these policies and the mechanisms by which these three variables interact with each other.



ness and intensity of instruction is the amount of emphasis a teacher gives to a particular achievement group. In heterogeneous classes, this emphasis is a function of a teacher's *desired* emphasis and the competing demands of other groups. It is central to our theory of schooling that the perceived learning gap between teacher expectations and the level of achievement is a major determinant of teacher emphasis. A teacher will want to devote more emphasis to a particular achievement group if the teacher perceives a gap in achievement. If there is no gap between expectations and achievement, there will be no effort to increase the emphasis for a particular group. In the effective school, expectations are based solely on standards and not on past achievement. Consequently, there is a significant gap in achievement for the initially low achievers and teachers want to place more emphasis on these students to raise their achievement. In the ineffective school, because expectations are based solely on past performance (when achievement is low, expectations are low), there is no perceived learning gap and no desire to improve instruction.

Teacher expectations also have a direct impact on teacher emphasis. If teacher expectations are below grade level standards, there is a systematic bias against those students for whom the teacher has low expectations (see Rist, 1973). Thus, the teacher who has low expectations for a particular achievement group will place less emphasis on that group. Therefore, the appropriateness and intensity of instruction and engaged time for the group will be less than normal and achievement will suffer.

Incorporated in the theory is the idea that the transition to school effectiveness is a developmental process. Success leads to more success. When teachers perceive success (for example, when the achievement gap for initially low achievers at the end of the sixth grade is less than their initial gap when they entered the first grade), teacher expectations at all grade levels begin to rise. This results in a larger perceived learning gap for low-achieving students and, consequently, more effort and concern on the part of teachers to provide more appropriate and intense instruction. This leads to further gains in achievement, more success, and higher expecta-

tions. Thus, the link between achievement and expectations shown in Figure 1 operates to *lower* expectations in the ineffective school and to *raise* expectations in the improving school.

There are four main feedback structures that influence achievement in our theory of schooling. Three of these are positive feedback loops that *reinforce* existing patterns of achievement (see Figure 1 and footnote 4). They are: (1) the loop encompassing achievement, motivation, and engaged time; (2) the loop connecting motivation, behavior, time for instruction, and appropriateness and intensity of instruction; and (3) the loop between achievement, expectations, teacher emphasis, appropriateness and intensity of instruction, and learning. Without intervention, these positive feedback structures cannot transform an ineffective school into an effective one.

The fourth structure is a negative feedback loop involving achievement, the perceived learning gap, appropriateness and intensity of instruction, and learning. This negative loop operates to *correct* discrepancies between low student achievement and higher teacher expectations. This loop *collapses* in the ineffective school for the low achievers because expectations are the same as current achievement. As a consequence, ineffective schools only *reinforce* initial differences in achievement and the initially low achievers fall further and further behind.

The key to moving a school toward greater effectiveness lies in activating this negative loop. This can be accomplished either by direct efforts to raise teacher expectations to grade level standards (or above) or by interventions designed to raise achievement and, as a result, cause teachers to readjust their expectations.

#### From Theory to Simulation Model

The computer model, which incorporates the dynamic theory of schooling described earlier, simulates the flow of successive groups of initially low-, average-, and high-achieving children through six years of schooling in a typical urban elementary school.<sup>6</sup> In each grade, students learn, behave, and are motivated according to the conditions in the classroom and school that affect them. At the end of each year,

they move to the next grade, taking their attributes of achievement, motivation, and behavior with them. To reduce complexity, the model assumes that there is no student absenteeism or turnover and that the only difference among entering students is their initial level of achievement.<sup>7</sup> The model also represents a teaching staff who enter and leave the school and who have certain skills and expectations for student achievement. School administrators are not included in the model structure because they are not directly involved in the instructional process. Their roles are those of setting policies, exerting pressure, and improving the staff through inservice or recruitment.

There is nothing in the model that will allow the ineffective school to self-generate the conditions required for the transition to greater effectiveness. The school will not begin the transformation process unless there is a *catalyst* for change. That catalyst may be a strong, dynamic principal, a cadre of highly motivated teachers, or strong parental or school district pressure. While individual teachers or parents may be concerned about achievement, it seems clear in the literature on effective schooling that without intervention by the principal there is typically no concerted effort to bring about change and no change occurs. Therefore, in our policy analysis we have described interventions as if they were initiated by the principal.

#### Policy Conclusions

Points of intervention for a school principal who wishes to move a school toward effectiveness are indicated in Figure 1. These interventions focus primarily on improving the appropriateness and intensity of instruction for low achievers by changing policies affecting time allocations, improving teacher effectiveness (either through recruitment or staff development), encouraging teachers to place more emphasis on low achievers, and by raising teacher expectations. Some of these policies might be aimed directly at low achievers while others might encompass the entire school. In addition, principals can focus on improving classroom or schoolwide behavior, on changing class size, or on changing the demographics of the student body (for example, size, percentage

of low achievers). In our policy analysis, we evaluated the consequences of implementing policies in each of these areas. This was accomplished by making structural or parameter changes in the model to reflect the policy being tested and by measuring the impact of the policy on a simulated ineffective school.

The central conclusion of the policy analysis is that there *do* exist policies that can either erase or greatly reduce the achievement gap for low achievers. The most effective school improvement strategies are those that better teacher skills, raise teacher expectations for low-achieving students, and maximize time available for instruction. It is more effective to accomplish these goals through staff development, rather than through recruitment, provided that inservice training occurs *outside of regular class hours* and does not take time away from instruction. This training must focus on raising teacher expectations for low-achieving students and on directly improving skills of mastery learning and direct instruction. Supervision must help teachers to integrate the lessons of inservice training in their teaching. Supervision and training must help teachers to intensify their instruction and to enhance their teaching skills, yet must not take teachers away from teaching children.

Maximizing the time available for instruction and increasing the efficient use of that time should be central concerns of school administrators. Time for noninstructional activities should be closely monitored and reduced whenever possible. Nothing should be allowed to interfere with instructional time. The allocation of instructional time among subjects is also important. Analysis suggests that a careful adjustment of time between reading instruction and instruction in other content areas can enhance achievement in reading as well as in the other areas.

Teachers and principals often are very concerned about behavior and discipline (see Phi Delta Kappa, 1980). A corollary to our central conclusion is that efforts to improve behavior should not diminish time for instruction. These efforts can take two forms: (1) improving behavior directly through behavior modification and/or through altering the climate of expectations for behavior in the school; and (2) improving behav-

ior indirectly by improving the appropriateness and intensity of instruction. Efforts to improve behavior should emphasize interventions outside of the classroom and efforts in the classroom should focus as much as possible on improving instruction. The role of the principal in developing structures to improve behavior seems critical. Such structures may include focusing administrative time on working with students outside of class and on organizing teachers and parents in setting expectations for student behavior.

Parents may also be systematically involved in improving instruction outside of regular classroom hours. Strategies for schools may include: (1) working with parents to improve time on task at home (by enhancing the climate at home for doing homework and by setting expectations for their children for doing homework); and (2) training parents to teach their children at home when they need extra help. Such strategies give a meaning to "parent involvement" that is specifically related to improving the appropriateness and intensity of instruction for their children. Of course, the effectiveness of strategies for involving parents may also depend on the input parents have in shaping the curriculum, on the extent of their trust in the teachers and the principal and, ultimately, on the extent to which they participate in a variety of decisions about their children in particular and about the school in general (see Davies, 1980).

### Implications for Improving Schools

To summarize, there are several broad implications for those involved in school improvement that emerge from our research. First, no sustained improvement can occur unless there is longitudinal monitoring and assessment of pupil achievement. Feedback about achievement is essential to parents, teachers, and principals in planning for improvement. However, data on achievement must be *disaggregated* to focus on the achievement patterns over time of different groups of students. When effectiveness is measured by indicators of *average* achievement, a school that is structurally ineffective can appear to be effective because of demographic characteristics (for example, a low fraction of initially low achievers in the student body).

Second, feedback is important only if there are standards for assessment. No efforts will be made to close the achievement gap for initially low achievers if expectations are low and no learning gap is perceived. Third, a school that maximizes time for instruction, commits resources to basic skills, and shapes a climate that underscores the importance of instruction can achieve significant gains—even without a cadre of "super" teachers. Fourth, our research gives meaning to the plea for "strong administrative leadership." Our policy analyses show that a strong leader is one who sets policies that enhance time for instruction, one who maintains a supportive school climate, and, most important, one who is able to implement programs of supervision and training that raise teacher skills and expectations in ways that are directly transferable to the classroom. Fifth, our research demonstrates the *interactive* nature of these variables and the importance of understanding the relationships among leadership, expectations, climate, instruction, and achievement *before* deciding on a specific set of policy interventions.

Finally, our analysis suggests that there is still much more to be learned about promoting enduring school effectiveness. More empirical research is needed to gather longitudinal data on such important variables as the allocation of time and student outcomes in effective, ineffective, and transitional schools. Further clarification of existing patterns is essential to improving our understanding of how the problems of ineffective schooling arise and to provide a foundation for evaluating school improvement efforts. We believe that the School Effectiveness Model, and the theory upon which it is founded, represent precisely the kind of integrative efforts needed to guide further research and practice and to continue to build systematically a useful base of knowledge about schools as instructional systems.

Other empirical research should focus on understanding the dynamics of organizational change processes invoked by attempts to implement school improvement strategies. This understanding will yield important benefits both for policy analysis and for the training of school administrators. It shifts policy analysis from the ideal state, where one assumes that all interventions can be

implemented, to the real world, where policies must be evaluated to maximize long-term gains and to minimize cost, resistance, and system instability. In addition, efforts are needed to integrate the findings of research on the causal dynamics affecting school effectiveness into the preservice and inservice training programs for school administrators. □

<sup>1</sup>See Bridge and others (1979); Harnischfeger and Wiley (1980); and Thomas (1977).

<sup>2</sup>A more complete description of our work can be found in Clauset and Gaynor (1982) and Clauset and Gaynor (in preparation).

<sup>3</sup>System Dynamics is a particular form of systems analysis that was developed at MIT during the late 1950s and has been refined in a variety of applications over the last quarter century. It includes a set of tools and techniques for developing computer simulation models of dynamic causal structures. For a more detailed introduction to System Dynamics see Forrester (1968) or Richardson and Pugh (1981).

<sup>4</sup>Feedback structures are of two general types. "Positive" feedback structures include causal relationships among variables that are mutually self-reinforcing. The relationship between wages and prices within the dynamics of inflation and depression is an example of the concept of positive feedback. "Negative" feedback structures are characterized by goal-seeking behavior. In such a system, the effect of one variable on another is the *opposite* of the effect of the second variable upon the first. A thermostat is a negative feedback system. The heat goes *on* as the temperature goes *down* and *off* as the temperature goes *up*. Causal theories developed from the System Dynamics perspective emphasize the interactive effects of multiple feedback structures and the idea that shifting dominance among feedback structures produces variations in system behavior.

<sup>5</sup>The effect of expectations on instruction is found repeatedly in the literature (Benjamin, 1980; Brophy and Good, 1970; Brookover and others, 1979; Edmonds, 1979; Phi Delta Kappa, 1980; Rosenthal and Jacobson, 1968; Salganik, 1980; Weber, 1971).

<sup>6</sup>The model parameters can be adjusted to represent a specific school. Thus, a school staff could use the model to project patterns of student outcomes and school characteristics over time under different environmental or policy conditions.

<sup>7</sup>While every urban administrator knows this "just isn't so," we felt that this was a reasonable simplification since absenteeism and turnover would only worsen the problem of ineffectiveness.

Although variations in student aptitude are important, they do not change the institutional responses to achievement patterns

and are not necessary to produce the differential patterns of achievement that characterize most schools. In this model, we have assumed that students with different levels of initial achievement have the same aptitude for learning.

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