A Model of Effective Instruction

Robert E. Slavin

Center for Research on the Education of Students Placed at Risk
Johns Hopkins University

This paper is adapted from Slavin (1987a) and Slavin (1994). It was written under funding from the Office of Educational Research and Improvement, U.S. Department of Education (No. OERI-R-117-R-90002).

However, any opinions expressed are those of the author and do not represent OERI positions or policies.

In the past twenty years, research on teaching has made significant strides in identifying teaching behaviors associated with high student achievement (Brophy and Good 1986; Rosenshine and Stevens 1986). However, effective instruction is not just good teaching. If it were, we could probably find the best lecturers, make video tapes of their lessons, and show them to students (see Slavin 1994).

Consider why the video teacher would be ineffective. First, the video teacher would have no idea what students already knew. A particular lesson might be too advanced for a particular group of students, or it may be that some students already know the material being taught. Some students may be learning the lesson quite well, while others are missing key concepts and falling behind because they lack prerequisite skills for new learning. The video teacher would have no way to know who needed additional help, and would have no way to provide it in any case. There would be no way to question students to find out if they were getting the main points and then to reteach any concepts students were failing to grasp.

Second, the video teacher would have no way to motivate students to pay attention to the lesson or to really try to learn it. If students were failing to pay attention or were misbehaving, the video teacher would have no way to do anything about it. Finally, the video teacher would never know at the end of the lesson whether or not students actually learned the main concepts or skills.

The case of the video teacher illustrates the point that teachers must be concerned with many elements of instruction in addition to the lesson itself. Teachers must attend to ways of adapting instruction to students' levels of knowledge, motivating students to learn, managing student behavior, grouping students for instruction, and testing and evaluating students. These functions are carried out at two levels. At the school level, the principal and/or central administrators may establish policies concerning grouping of students (e.g., tracking), provision and allocation of special education and remedial resources, and grading, evaluation, and promotion practices. At the classroom level, teachers control the grouping of students within the class, teaching techniques, classroom management methods, informal incentives, frequency and form of quizzes and tests, and so on. These elements of school and classroom organization are at least as important for student achievement as the quality of teachers' lessons.

This paper presents a model of effective instruction which attempts to identify the critical elements of schools and classroom organization and their interrelationships. This model, based on the work of John Carroll (1963, 1989), focuses on the alterable elements of Carroll's model, those which teachers and schools can directly change (see Slavin 1984; 1987a; 1994). The components of this model are as follows:

1. ***Quality of Instruction*. The degree to which information or skills are presented so that students can easily learn them. Quality of instruction is largely a product of the quality of the curriculum and of the lesson presentation itself.**
2. ***Appropriate Levels of Instruction:* The degree to which the teacher makes sure that students are ready to learn a new lesson (that is, they have the necessary skills and knowledge to learn it) but have not already learned the lesson. In other words, the level of instruction is appropriate when a lesson is nether too difficult nor too easy for students.**
3. ***Incentive:* The degree to which the teacher makes sure that students are motivated to work on instructional tasks and to learn the material being presented.**
4. ***Time:* The degree to which students are given enough time to learn the material being taught.**

The four elements of this QAIT (Quality, Appropriateness, Incentive, Time) model have one important characteristic: All four must be adequate for instruction to be effective. Again, effective instruction is not just good teaching. No matter how high the quality of instruction, students will not learn a lesson if they lack the necessary prior skills or information, if they lack the motivation, or if they lack the time they need to learn the lesson. On the other hand, if the quality of instruction is low, then it may makes little difference how much students know, how motivated they are, or how much time they have. Each of the elements of the QAIT model is like a link in a chain, and the chain is only as strong as its weakest link. In fact, it may be hypothesized that the four elements are multiplicatively related, in that improvements in multiple elements may produce substantially larger learning gains than improvements in any one.

Effective Classroom Organization

Most of the advances in research on teaching have come about as a result of correlational process-product research, in which the practices of instructionally effective teachers have been contrasted with those of less effective teachers, controlling for student inputs (Brophy and Good 1986). The findings of these process-product studies have often been incorporated into coherent instructional programs and evaluated in field experiments (Gage and Needels 1989). Other coherent instructional methods not based on the process-product findings, such as mastery learning, cooperative learning, tutoring, and individualized instruction methods, have also been evaluated in field experiments. Each of these instructional methods is based on its own psychological or educational theories. However, it is the purpose of this paper to propose a theory to encompass all potential forms of classroom organization. Given a relatively fixed set of resources, every innovation in classroom organization solves some problems but also creates new problems which must themselves be solved. Tradeoffs are always involved. Understanding the terms of these tradeoffs is critical for an understanding of how to build effective models of classroom organization.

The QAIT model is designed primarily to clarify the tradeoffs involved in alternative forms of classroom organization. This article presents a perspective on what is known now about each of the QAIT elements, and more importantly explores the theoretical and practical ramifications of the interdependence of these elements for effective school and classroom organization.

Quality of Instruction

Quality of instruction refers to the activities we think of first when we think of teaching: lecturing, discussing, calling on students, and so on. It also includes the curriculum and books, software, or other materials. When instruction is high in quality, the information being presented makes sense to students, is interesting to them, is easy to remember and apply.

The most important aspect of instructional quality is the degree to which the lesson makes sense to students. For example, teachers must present information in an organized orderly way (Kallison 1986), note transitions to new topics (Smith and Cotton 1980), use clear and simple language (Land 1987), use many vivid images and examples (Hiebert et al. 1991; Mayer & Gallini 1990), and frequently restate essential principles (Maddox and Hoole 1975). Lessons should be related to students' background knowledge, using such devices as advance organizers (Pressley et al. 1992) or simply reminding students of previously learned material at relevant points in the lesson. The teacher's enthusiasm (Abrami, Leventhal, and Perry 1982) and humor (Kaplan and Pascoe 1977) can also contribute to quality of instruction, as can use of media and other visual representations of concepts (Hiebert, Wearne, and Taber 1991; Kozma 1991).

Clear specification of lesson objectives to students (Melton 1978) and a substantial correlation between what is taught and what is assessed (Cooley and Leinhardt 1980) contribute to instructional quality, as does frequent formal or informal assessment to see that students are mastering what is being taught (Crooks 1988; Kulik and Kulik 1988) and immediate feedback to students on the correctness of their performances (Barringer and Gholson 1979).

Instructional pace is partly an issue of quality of instruction and partly of appropriate levels of instruction. In general, content coverage is strongly related to student achievement (Dunkin 1978; Barr and Dreeben 1983), so a rapid pace of instruction may contribute to instructional quality. However, there is obviously such a thing as too rapid an instructional pace (see Leighton and Slavin 1988). Frequent assessment of student learning is critical for teachers to establish the most rapid instructional pace consistent with the preparedness and learning rate of all students.

Appropriate Levels of Instruction

Perhaps the most difficult problem of school and classroom organization is accommodating instruction to the needs of students with different levels of prior knowledge and different learning rates. If a teacher presents a lesson on long division to a heterogeneous class, some students may fail to learn it because they have not mastered such prerequisite skills as subtraction, multiplication, or simple division. At the same time, there may be some students who know how to divide before the lesson begins, or learn to do so very rapidly. If the teacher sets a pace of instruction appropriate to the needs of the students lacking prerequisite skills, then the rapid learners' time will be largely wasted. If the instructional pace is too rapid, the students lacking prerequisite skills will be left behind.

There are many common means of attempting to accommodate instruction to students' diverse needs, but each method has drawbacks that may make the method counterproductive. Various forms of ability grouping seek to reduce the heterogeneity of instructional groups. Special education and remedial programs are a special form of ability grouping designed to provide special resources to accelerate the achievement of students with learning problems. However, between-class ability grouping plans, such as tracking, can create low-ability classes for which teachers have low expectations and maintain a slow pace of instruction, and which many teachers dislike to teach (Good and Marshall 1984; Oakes 1985; 1987; Rowan and Miracle 1983; Slavin 1987b; 1990a). Similar problems make self-contained special education classes of questionable benefit to students with learning handicaps (see Leinhardt and Bickel 1987; Leinhardt and Pallay 1982; Madden and Slavin 1983). Within-class ability grouping, such as the use of reading and mathematics groups, creates problems of managing multiple groups within the classroom, reduces direct instruction to each student, and forces teachers to assign large amounts of unsupervised seatwork to keep students engaged while the teacher is working with a reading or mathematics group (Anderson, Evertson, and Brophy 1979; Barr 1992).

Research on assignment of students to ability-grouped classes finds no achievement benefits for this practice at the elementary or secondary levels (see Slavin 1987b; 1990a; Oakes 1985; 1987). However, forms of ability grouping in which elementary students remain in heterogeneous classes most of the day but are regrouped into homogeneous reading or mathematics classes can be instructionally effective if teachers actually adapt their level and pace of instruction to meet the needs of the regrouped classes. In particular, the Joplin Plan and certain nongraded plans in which elementary students are regrouped for reading or mathematics across grade lines and instructional level is based on performance level rather than age can be instructionally effective (Slavin 1987b; Gutíerrez and Slavin 1992). Also, research on within-class ability grouping finds this practice to increase student mathematics achievement, particularly when the number of groups used is small and management techniques designed to ensure smooth transitions and high time-on-task during seatwork are used (Slavin 1987b; Slavin and Karweit 1985).

Group-based mastery learning (Bloom 1976; Block and Burns 1976; Guskey and Gates 1985) is an approach to providing levels of instruction that does not use permanent ability groups but rather regroups students after each skill is taught on the basis of their mastery of that skill. Students who attain pre-set criteria (e.g., 80%) on a formative test work on enrichment studies while non-masters receive corrective instruction. In theory, mastery learning should provide appropriate levels of instruction by ensuring that students have mastered prerequisite skills before they receive instruction in subsequent skills. However, within the confines of traditional class periods, the time needed for corrective instruction may slow the pace of instruction for the class as a whole. Studies of group-based mastery learning conducted in elementary and secondary schools over periods of at least four weeks have found few benefits of this approach in comparison to control groups given the same objectives, materials, and time as the mastery learning groups (Slavin 1987c).

The most extreme form of accommodation to individual differences short of one-to-one tutoring is individualized instruction, in which students work entirely at their own level and rate. Individualized instruction certainly solves the problem of providing appropriate levels of instruction, but it creates serious problems of classroom management, often depriving students of adequate direct instruction. Research on individualized instruction has not generally found positive effects on student achievement (Hartley 1977; Horak 1981). However, Team Assisted Individualization, a form of individualized instruction which also incorporates the use of cooperative learning groups, has been found to consistently increase student achievement in mathematics (Slavin, Leavey, and Madden 1984; Slavin, Madden, and Leavey 1984; Slavin and Karweit 1985; Slavin 1985).

Incentive

Thomas Edison once wrote that "genius is one percent inspiration and ninety-nine percent perspiration." The same could probably be said for learning. Learning is work. This is not to say that learning must be drudgery, but it is certainly the case that students must exert themselves to pay attention, to study, and to conscientiously perform the tasks assigned to them, and they must somehow be motivated to do these things. This motivation may come from the intrinsic interest value of the material being learned, or may be created through the use of extrinsic incentives, such as praise, grades, stars, and so on (see Stipek 1993).

If students want to know something, they will be more likely to exert the necessary effort to learn it. This is why there are students who can rattle off the names, and statistics relating to every player on their favorite sports team, but do not know their multiplication facts. Teachers can create intrinsic interest in material to be taught by arousing student curiosity, for example by using surprising demonstrations, by relating topics to students' personal lives, or by allowing students to discover information for themselves (Brophy 1987; Malone and Lepper 1988).

However, not every subject can be made intrinsically interesting to every student at all times. Most students need some sort of extrinsic incentive to exert an adequate level of effort on most school tasks. For example, studies of graded versus pass-fail college courses find substantially higher achievement in classes that give grades (Gold, Reilly, Silberman, and Lehr 1971; Hales, Bain, and Rand 1971). At the elementary level, informal incentives, such as praise and feedback, may be more important than the formal grading system (see Brophy 1987). One critical principal of effective use of classroom incentives is that students should generally be held accountable for what they do. For example, homework that is checked has been found to contribute more to students achievement than homework that is assigned but not checked (Cooper 1989). Also, questioning strategies that communicate high expectations for students, such as waiting for them to respond (Rowe 1974) and following up with students who do not initially give full responses (Brophy and Evertson 1974) have been found to be associated with high achievement (see Good 1987).

Several methods of providing formal incentives for learning have been found to be instructionally effective. One practical and effective method of rewarding students for appropriate, learning-oriented behavior is home-based reinforcement (Barth 1979), provision of daily or weekly reports to parents on student behavior. Another is group contingencies (Dolan et al. 1993; Hayes 1976), in which the entire class or groups within the class are rewarded on the basis of the behavior of the entire group.

Cooperative learning methods (Slavin 1990b) involve students working in small learning groups to master academic material. Forms of cooperative learning that have consistently increased student achievement have provided rewards to heterogeneous groups based on the learning of their members. This incentive system motivates students to encourage and help one another to achieve. Rewarding students based on improvement over their own past performance has also been found to be an effective incentive system (Natriello 1987; Slavin 1980).

In addition to being a product of specific strategies designed to increase student motivation, incentive is also influenced by quality of instruction and appropriate levels of instruction. Students will be more motivated to learn about a topic that is presented in an interesting way, that makes sense to them, that they feel capable of learning. Further, a student's motivation to exert maximum effort will be influenced by their perception of the difference between their probability of success if they do exert themselves and their probability of success if they do not (Atkinson and Birch 1978; Slavin 1977; 1994). That is, if a student feels sure of success or, alternatively, of failure, regardless of his or her efforts, then incentive will be very low. This is likely to be the case if a lesson is presented at a level much too easy or too difficult for the student. Incentive is high when the level of instruction is appropriate for a student, so that the student perceives that with effort the material can be mastered, so that the payoff for effort is perceived to be great.

Time

Instruction takes time. More time spent teaching a subject does not always translate into additional learning, but if instructional quality, appropriateness of instruction, and incentives for learning are all high, then more time on instruction is likely to pay off in greater learning.

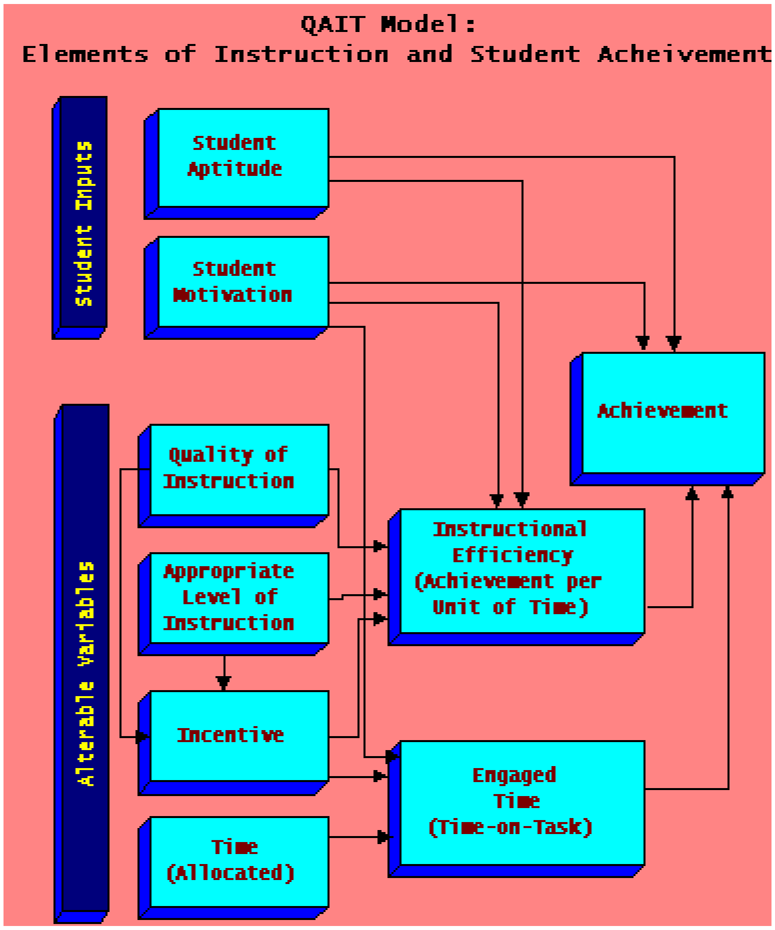
The amount of time available for learning depends largely on two factors: Allocated time and engaged time. Allocated time is the time scheduled by the teacher for a particular lesson or subject and then actually used for instructional activities. Allocated time is mostly under the direct control of the school and teacher. In contrast, engaged time, the time students actually engage in learning tasks, is not under the direct control of the school or the teacher. Engaged time, or time-on-task, is largely a product of quality of instruction, student motivation, and allocated time. Thus, allocated time is an alterable element of instruction (like quality, appropriateness, and incentive), but engaged time is a mediating variable linking alterable variables with student achievement.

While allocated time must be an essential element in any model of classroom organization, research on this variable has found few consistent effects on student achievement. For example, research on hours in the school day and days in the school year has found few relationships between these time variables and student achievement (Frederick and Walberg 1980; Karweit 1989). The Beginning Teacher Evaluation Study found no effect of allocated time in specific subjects on student achievement in those subjects when time was measured at the class level (Marliave, Fisher, and Dishaw 1978). On the other hand, research on engaged time generally finds positive relationships between of time students are on task and their achievement, but even with this variable results are inconsistent (see Karweit 1989).

Studies of means of increasing student time on task generally go under the heading of classroom management research. Process-product studies (see, for example, Brophy and Good 1986) have established that teachers' use of effective management strategies is associated with high student achievement. However, several experimental studies focusing on increasing time on-task have found that it is possible to increase engaged time and still have no significant effect on student achievement (Emmer and Aussiker 1990; Slavin 1986; Stallings and Krasavage 1986).

A Model of Alterable Elements of Instruction and Student Achievement

The QAIT model can be conceptualized in terms of intermediate effects on time-related variables. The QAIT Model below depicts a model of how alterable elements of instruction might affect student achievement.



In this chart, two types of independent variables are presented: Student inputs and alterable variables. Student inputs refer to factors over which the school has little control in the short run: Student aptitide (including their prior knowledge of a subject) and those aspects of motivation to learn that students bring from home (as distinct from the motivation created by classroom practices). The alterable variables are the QAIT elements discussed earlier. Of course, student inputs are not unchangeable, but can be affected by classroom practices. For example, student aptitude to learn a specific lesson may be strongly influenced by background knowledge resulting from earlier instruction, by specific training in thinking, problem solving, or study skills, or by general intellectual stimulation or learning skills provided by the school. Student motivation to learn is also largely a product of past experiences in school. However, in the context of any given lesson, the student inputs can be considered fixed, while the alterable variables can be directly altered by the school or teacher.

The effects of the alterable variables on student achievement are held to be mediated by two time-related variables: Instructional efficiency and engaged time, or time-on-task. Instructional efficiency can be conceptualized as the amount of learning per time. For example, students will learn more in a ten-minute lesson high in instructional efficiency than in a lesson of similar length low in instructional efficiency. Engaged time is the amount of time students are actually participating in relevant learning activities, such as paying attention to lectures and doing assignments. Instructional efficiency and engaged time are multiplicatively related to student achievement; obviously, if either is zero, then learning is zero.

The QAIT model can be easily related to instructional efficiency and engaged time. Instructional efficiency is a product of the quality of instruction (e.g., organization and presentation quality of the lesson), appropriate levels of instruction (students have prerequisite skills but have not already learned the lesson), and incentive (students are interested in learning the lesson). Of course, aptitude and motivation also contribute to instructional efficiency for any given student. Engaged time is primarily a product of allocated time and incentive.

The relationship between improvements in each of the four alterable elements and effects on student achievement is held to be multiplicative. If any of the elements is at zero, learning will be zero. Above zero, the argument that the effects of the four elements are multiplicative rests in part on an assumption that effects of increasing each element are greatest at low levels and ultimately reach maximum levels. For example, motivation to learn will reach a maximum in terms of affecting student achievement at some point. Effects of quality and appropriateness of instruction are similarly likely to reach a point of diminishing returns. Time on-task not only cannot be increased beyond 100% of time allocated, but it is doubtful whether increases beyond, say, 90% produce significant increases in learning. This may explain why several studies which produced substantial gains in time on-task have produced minimal effects on student achievement (see Emmer and Aussiker 1990; Slavin 1986).

The substantive implication of a multiplicative relationship among the QAIT elements is that it may be more effective to design instruction to produce moderate gains in two or more elements than maximize gains in only one. To increase a plant's growth, moderate increases in light, water, and fertilizer are likely to be more productive than large increases in only one of these elements. By the same token, substantial increases in any one element of the QAIT model, leaving all others unaffected, is likely to be less effective than more moderate, across-the-board improvements.

Another implication of the assumption that there is a point of diminishing returns in the achievement effect of each of the QAIT elements is that different types of programs or teaching emphases will work differently in different settings depending on pre-existing levels of each. For example, an emphasis on increasing time on-task is likely to be more effective in classrooms low on this variable than in those beginning at 80-90% levels. Highly motivated students may profit more from programs focusing on providing appropriate levels of instruction than from motivationally focused programs, and so on.

Conclusion

The most important implication of the QAIT model is that teachers need to focus on each of the four elements of effective instruction - quality, appropriateness, incentive, and time - if they expect to make a substantial difference in student achievement. In particular, teachers need to be sure that if they solve problems relating to one element they do not cause new problems relating to another. For example, Slavin (1987a) explained the failure of individualized instruction programs of the 1970's by noting that what they gained in appropriate levels of instruction they often lost in quality of instruction, motivation, and time on task.

Clearly, effective teaching is an art and must be sensitive to context and to the particular needs of a given group of students. Yet research on effective strategies is useful to teachers in helping them make informed and intelligent choices of teaching strategies designed to accelerate student achievement.

References

Abrami, P.C., L. Leventhal, and R.P. Perry. 1982. Educational seduction. *Review of Educational Research* 52(3): 446-462.

http://www.successforall.org/_images/pdfs/modeleffect.htm