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ABSTRACT

This report contains an analysis of the mechanisms that connect teaching processes to student achievement and the circumstances contributing to the establishment of treatment conditions in classrooms. The first section is focused on the way in which academic tasks operating in a classroom influence the quality of student learning. The second section is directed to the consequences for students of four types of academic tasks and probable student reactions to these task structures. It is suggested that students develop strategies for managing the degree of ambiguity and risk inherent in classroom tasks. Special attention is given to the way in which attempts to achieve cooperation influence teacher planning and decision making. Implications of this analysis are drawn for interpreting teaching effectiveness data, planning preservice and inservice teacher education, and designing instructional improvements. (JD)

HOW DO TEACHING EFFECTS OCCUR?

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ABSTRACT

This report contains a conceptual analysis of (1) the mechanisms that connect teaching processes to student learning outcomes; and (2) the circumstances contributing to the establishment of treatment conditions in classrooms. The first section is focused on the way in which academic tasks operating in a classroom influence the quality of student learning. It is argued that academic tasks organize the way in which students process information in classrooms. The second section is directed to the consequences for students of four types of academic tasks and the probable student reactions to these task structures. Evidence is review which suggests that students develop strategies for managing the degree of ambiguity and risk inherent in classroom tasks. The third section concentrates on factors involved in accomplishing the basic teaching tasks in classrooms, namely, gaining and maintaining cooperation in activities. Special attention is given to the way in which attempts to achieve cooperation influence teacher planning and decision-making. Finally, implications of this analysis are drawn for interpreting teaching effectiveness data, planning preservice and inservice teacher education, and designing instructional improvements.

HOW DO TEACHING EFFECTS OCCUR?

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The question of how teaching effects occur is directed to the conceptual foundations of research on teaching effectiveness. Regardless of whether the methodology is quantitative or qualitative, it has become increasingly clear that the central problem for any investigator is how to interpret data about teaching and learning in classrooms. Solving the problem of interpretation requires, in turn, a more refined understanding of classroom phenomena and the construction of explicit treatment theories to account for relationships between processes and outcomes in teaching.

The work presented in this report is based on two major sources: (1) long-term naturalistic observations designed to map the event structure of classroom environments (Doyle, 1977a, 1979); and (2) extensive reviews of research on teaching and on human information processing (Doyle, 1978, Note 1). The analysis of this material has been guided by an ecological perspective as reflected in the writings of Kounin (1970), Gump (1969, 1975), and Willems (1973). A fundamental premise of this framework is that behavior, including thought, becomes tuned to the demands of a particular setting. To understand observational records of behavior, therefore, an investigator must carefully analyze the environment in which the behavior occurred. From this perspective, features of the classroom are viewed as environmental demands and the emphasis is on analyzing how these demands affect the thought and actions of teachers and students. Three special features of the ecological framework used in this analysis must be mentioned. First, the classroom is seen as an ordered and bounded setting with demands unique to that environment. Second, the analysis is focused primarily on group phenomena, on how the classroom system works rather than on predicting the behavior of particular individuals. Finally, the stance is fundamentally naturalistic, that is, the emphasis is on uncovering why naturally-occurring practices persist rather than on how these practices can be changed.

The report is organized around three major headings: (1) the effect of classroom task structures on student learning outcomes; (2) the task of learning in classrooms; and (3) the task of teaching in classrooms. The first topic relates directly to the question of a treatment theory for research on teaching. The second and third topics focus on the circumstances that bring about treatment conditions in classrooms.

Classroom Task Structures and Student Learning Outcomes

The environment for student learning is most often discussed with reference to the subject matter to be learned (e.g., mathematics, reading, science) and the actions of teachers (e.g., explanations, questions, feedback) that presumably aid students in achieving mastery of such content. In short-term laboratory studies this definition of the environment for student learning is appropriate. But learning in classrooms takes place over a long period of time, in a group setting with multiple resources, and in an evaluative context (Jackson, 1968) that shapes student learning processes in distinctive ways. Students are periodically called upon to display knowledge and skills under specified conditions: they take tests, complete assignments, answer questions in discussions, and so forth. The adequacy of their performance during these activities is labeled by the teacher and these labels are recorded and usually communicated to others. This formalized exchange of performance for grades (Becker, Geer, & Hughes, 1968) establishes an important set of consequences for students and frames the way in which subject matter is experienced in classrooms (Doyle, 1978).

The Quality of Student Learning

From the students' perspective, the performance-grade exchange defines the structure of academic tasks for a given classroom. The demands of these academic tasks influence, in turn, how information is processed and, thus, what is learned. The requirement to reproduce from memory information given in the textbook involves different cognitive processes than the requirement to remember the gist of the information or draw inferences from what is read (Brown, 1975). Similarly, a task that demands recall of solutions to problems solved in class is different from one that demands the application of solution strategies to new problems. This analysis suggests that what students learn in classrooms is a function of the operations they use to accomplish academic tasks.

A very clear picture of the effect of task structures on outcomes is contained in Barr's (1975) study of reading strategies used by first graders. Barr examined the substitution errors pupils made when encountering unfamiliar words in text. Pupils taught by the sight-word method substituted words from the sample of reading words contained in the instructional materials, made few non-word responses, and showed little letter-sound correspondence in attempts to identify unfamiliar words. Pupils taught by a phonics method made more non-word or partial-word responses, showed high letter-sound correspondence in making substitutions, and substituted words not contained in the instructional materials. These results would seem to be strong evidence that the way students process information is consistent with the performance-grade exchange defined by a particular instructional method. As further support, Barr also found that students who entered instruction with a strategy inconsistent with the instructional emphasis tended to modify their strategy to match that required by the method with which they were taught. Students learned, in other words, to process information in a way that generated responses consistent with the demands of the classroom tasks they experienced.

Students also develop solution strategies that are reliable but hardly accurate or efficient. Using careful and intensive interviews, Erlwanger (1975) discovered students who had fundamentally erroneous conceptions of mathematics. These students had devised ways of getting correct answers that worked only for a very limited range of problems, violated basic assumptions in mathematics, and reflected little understanding of mathematical principles. An illustration of this kind of strategy--Erlwanger's examples are considerably more bizarre--involves the use of "counting points" (a "3" has three counting points at the ends of the lines) to add numbers. The system is highly reliable for accomplishing classroom tasks but hardly efficient or useful for learning how to add.

It is important to emphasize that this analysis of task structures is directed to qualitative rather than strictly quantitative aspects of student learning. Exposure to content, or opportunity to learn, is associated with the amount that students learn (Rosenshine, 1976; Walker & Schaffarzick, 1974). According to the present analysis, exposure to the same content under different task conditions is likely to influence how students process information and, thus, what they learn (Marton & Saljo, 1976; Mayer & Greeno, 1972; Tamir, 1975). Such an approach leads to a more refined analysis of student achievement and of the effects of schooling.

Selecting and Interpreting Instructional Cues

Students spend a long period of time in classrooms. Hence the quantity of information they receive is large. However, the quality of information is not always high. Goals are frequently unclear, instructions incomplete, feedback inaccurate, and materials inappropriate to the ability levels of the students. To accomplish classroom tasks, students must, therefore, exercise selective attention. More specifically, they must acquire a set of skills to identify task demands, adjust perceptions of these demands as they fluctuate over time, and compensate for gaps in information. Knowledge of subject matter is not sufficient for learning in classrooms. A student must also be able to locate and use cue resources available in the classroom environment.

The structure of academic tasks in a classroom would seem to define a framework with which students can excise selective attention. Knowledge of the type of academic tasks operating in a particular setting would enable students to direct conscious processing accurately, ignore information irrelevant to a successful performance-grade exchange, and concentrate on that required for task accomplishment. A student may, for instance, make little effort to acquire problem solving skills if academic tasks can be accomplished by simply recalling solutions arrived at by the teacher or by other students in class. Knowledge of the task structure, in other words, enables a student to <u>understand</u> the academic system and therefore <u>predict</u> the likelihood of certain events in that system (Schank & Abelson, 1977).

From a slightly different perspective, the academic task structure would also seem to serve as a mnemonic device to facilitate memory for information previously encountered in classrooms. It would seem to provide, in other words, a semantic framework for coding, storing, and retrieving information that is made available to students through the various cue resources in a particular classroom setting (on this point, see Kintsch, 1975). Such a view suggests that knowledge of subject matter gained in classroom settings is episodic (Tulving, 1972), i.e., embedded in the concrete features of task structures and their management. The approach also implies that classroom-based knowledge of subject matter is integrated semantically in terms of task structures defined by the classroom setting rather than by the content itself. These propositions are consistent with findings by Duke, Muzio, and Wagner (Note 2) that students had difficulty recalling what they had learned in a course when asked by an outside interviewer. The interview situation Duke used may have simply lacked the necessary retrieval cues and a common language to enable students to recall and discuss classroom-based knowledge of subject matter.

Summary

This preliminary investigation of academic task structures suggests that many important teacher effects occur indirectly through the tasks teachers establish rather than directly through teacher actions in the classroom. Indeed, the effect of teacher actions would seem to depend on their relationships to academic tasks. Behaviors that communicate information about the nature of academic tasks or the operations necessary to accomplish these tasks would affect student learning. Behaviors not related to the task structure are not likely to have an effect on outcomes. In this light, teacher behaviors are analyzed as information cues rather than as reinforcing stimuli.

Two additional examples are helpful in understanding how students interpret the classroom activities in which academic tasks are embedded. The first is taken from the report by Bussis, Chittenden, and Amarel (Note 3) on their observations of reading instruction in classrooms. These observations suggest that students may not label activities in the same way we do. For some students, decoding exercises were not reading: reading was when you got to sit next to your best friend and do stories.

Second, students had very idiosyncratic ways of learning to read. Some refused to read in public until they were proficient readers. Others "faked" it by only participating when they were allowed to "read" books they had memorized at home. Yet all of these students learned to read by the end of the year. The second example has to do with attitudes toward content. A fourth grader once told me he hated language. When asked why, he described the worksheet exercises he had to do in class. The first half required him to copy sentences; for the second half, he had to make up his own sentences. He said: "When you copy you have to 'scrunch' all those words in that little space. When you make up your own, you can make up short ones that fit." His attitude toward language, then, would seem to be based in part on his dislike of "scrunching!" This example suggests that student attitudes toward subject matter are also specific to the tasks they experience in classrooms.

The Task of Learning in Classrooms

Understanding the student perspective in teaching can be further enhanced by investigating the task of learning in classroom environments. The basic argument is as follows. Different academic tasks and different ways of administering these tasks affect the probability and the efficiency of task accomplishment. Different task structures, in other words, influence the possibility of a favorable performance-grade exchange. At a more immediate level, these differences in task structures would seem to be experienced in terms of the degrees of ambiguity and risk associated with task accomplishment. <u>Ambiguity</u>, as used here, is a result of gaps in information about performance expectations, that is, which answers will be required. <u>Risk</u> refers to the likelihood of not being able to meet task demands on a particular occasion. Since ambiguity and risk have strong emotional consequences, they provide a useful avenue for investigating the extent to which student attitudes toward subject matter are influenced by the nature of the tasks students are required to accomplish in classrooms.

<u>Types of Academic Task Structures</u>

To illustrate the direction of this analysis, a preliminary attempt has been made to identify different types of academic task structures in terms of the dimensions of ambiguity and risk (see Figure 1). The first type has been labeled "understanding." In this task structure students are required to learn a set of generative principles or operations which are then applied to unencountered instances in order to derive answers (see Anderson, 1972). The particular form of the answer, however, cannot be predicted completely in advance. The task, in other words, is to generate rather than reproduce an answer. This type of task structure would seem to be characteristic of "discovery" or "inquiry" classes. Accomplishing "understanding" tasks would appear to involve high levels of both ambiguity and risk. One might speculate that, with an average student population, overall attitudes toward the task structure would be moderate to low and achievement would be limited to highly skilled students.

		RISK	
		High	**Low**
AMBIGUITY	**High**	"Understanding"	"No Task"
	Low	"Memory II"	"Memory I"

Figure 1: Typology of academic task structures defined by the interaction of ambiguity and risk.

There are two types of classroom task structures defined primarily by memory, i.e.; the demand to reproduce information previously encountered during instruction. In "Memory I" task structures (see Figure 1), there is low ambiguity about performance expectations--everyone knows what information they are supposed to memorize--and risk is low because the total amount to be memorized is not very extensive. Accomplishing such tasks can be dull, but achievement rates will probably be high. In "Memory II" task structures, the emphasis is still on reproducing answers, but the amount to be reproduced is large. This is the proverbial "hard course," i.e., ambiguity is low but risk is high. Students often respect such courses and mean achievement would probably be moderate with considerable variance.

The final type has been called a "no task " structure. In this setting, there is high ambiguity but low risk. In other words, no one is sure what he or she is supposed to do, but it doesn't really matter because any answer is acceptable.

This typology is incomplete in the sense that it focuses on inherent features of task structures and ignores the way in which structures are managed by teachers in classrooms. Task structures are enacted in complex settings which contribute to the degree of ambiguity and risk involved in task accomplishment. When these contextual dimensions are added, the problems of learning from classrooms are intensified.

Student Control of Task Demands

Considerable evidence has accumulated in the past few years to indicate that students shape the classroom behavior of teachers (Emmer, Oakland, & Good, 1974; Fiedler, 1975; Klein, 1971; Sherman & Cormier, 1974) and that students control their own levels of participation in classroom activities (Noble & Nolan, 1976). Mehan (1974) has described ways in which students are able to accomplish classroom tasks in spite of ambiguity and risk. By giving provisional answers, imitating responses of others, or hesitating while answering until someone else--usually the teacher--supplied the answers for them, first-grade students were able to circumvent task demands and appear to accomplish tasks with little actual academic skill.

Of particular interest here, however, are ways in which students directly control the demands of academic tasks. Schellenberg's (1965) analysis suggests that students manage academic tasks by attempting to standardize and routinize assignments and by invoking "standards of democratic justice." In a particularly dramatic case of direct control, Davis and McKnight (1976) reported that junior high school students actively resisted an attempt by the teachers to modify the academic task structure of a mathematics course in a way that appeared to increase ambiguity and risk. The attempted modification consisted primarily of a shift in emphasis from a routine application of computation operations to a conceptualization of underlying mathematical principles, i.e., from memory to understanding. In expressing their resistance, some students argued that they had a right to know explicitly what they were expected to do.

This analysis suggests that when faced with academic task structures emphasizing understanding, students tend to create pressures to reduce the ambiguity and risk intrinsic to these structures. This can be accomplished in one of two ways. First, students can attempt to increase the number of environmental cues concerning the precise nature of performance expectations. They can, in other words, try to make the teacher more explicit about assignments, tests, etc. When cues become sufficiently explicit, the task structure shifts toward memory. Second, students can seek to reduce the risk associated with failure to meet performance requirements. They can, in other words, attempt to increase the teacher's generosity in assigning grades. If risks are reduced sufficiently, the result is a "no task" situation. If this analysis is accurate, then one is inclined to speculate that implementing academic task structures involving understanding is very difficult. In addition, making classroom cues more explicit should increase positive attitudes toward instruction--and much of the work on student ratings of college instructors supports this premise (Kulik & McKeachie, 1975)--and increase the apparent effectiveness of instruction (that is, more students will appear to accomplish classroom tasks). Questions can be raised, however, about what students learn under these conditions and how durable and transferable such teaching effects are (see Brown & Campione, Note 4).

The Task of Teaching in Classrooms

Further insight into the way students regulate classroom demands can be gained by examining the teacher's task in classrooms.

Cooperation in Classroom Activities

In most discussions, teaching is closely associated with learning. As a result the actions of teachers are judged almost exclusively as attempts to maximize student learning outcomes. In addition, the literature in teaching has a strong personalistic flavor so that much of what teachers do in classrooms is seen as evidence of personal competence and/or motivation. The study of classroom effects however, calls attention to environmental factors that must be considered in interpreting teacher behavior.

Teachers meet students in heterogeneous groups for designated periods of time and are required by general social norms to carry out activities that have educative purposes and involve all students. Moreover, these activities must be conducted over several months despite complications arising from absences of individual students, and interruptions from competing events in the school.

These realities of the classroom give rise to several distinctive and persistent features, including multidimensionality, simultaneity, immediacy, unpredictability, and history (see Doyle, 1977a). These terms simply mean that classrooms are crowded with people, activity, and interruptions; many events take place at the same time; and there is little time available for a teacher to reflect before acting or even to anticipate the course of events. In addition, classroom groups meet regularly over an extended period of time so that rules evolve for the behavior of teachers and students and decisions at one point have consequences for action in the future. It would also seem that these features are indigenous to classrooms. If teachers met their students one at a time and at the students' initiative, the setting for teaching would contain few of these elements.

The picture drawn here suggests that teachers encounter classrooms as units of time to be filled with activities that can be justified educationally and as a group of students who vary widely in aptitude and propensities for such activities. At a proximal level, then, the teacher's task as defined by these situational demands is to <u>gain and maintain cooperation in classroom activities</u>. The behavior of teachers, in turn, can be interpreted as operations designed to accomplish this task. Failure at this task has real and immediate consequences, since a teacher is responsible for a group regardless of whether cooperation is achieved or not. Given the qualities of the classroom environment, the task of securing cooperation would seem to be fundamentally problematic.

<u>Classroom Structures and Student Cooperation</u>

Cooperation is obviously influenced in numerous ways, including the inclination of students to participate in classroom activities and their skill in performing the operations required of classroom tasks. To explicate more fully the situational factors influencing student cooperation, the discussion focuses on tasks related to managing classroom groups.

Despite wide differences in individual characteristics, all classrooms, as social systems, embody rules for student conduct and a management system to enforce these rules (see Tikunoff & Ward, Note 5). Indeed, a fundamental property of activities is the format or set of rules for appropriate behavior of participants. Classroom rules can be part of the generally-shared knowledge of what is acceptable behavior (e.g., do not throw textbooks at light fixtures), reflect preferences of individual teachers (e.g., raise your hand before answering), or relate only to specific activities (e.g., spelling tests are numbered in two columns from 1-10 and from 11-20). Most students typically comply with classroom rules and transgressions are often minor. Nevertheless, violations of classroom rules are a regular feature of classroom life and a continuing source of concern for teachers (Coates & Thoresen, 1976).

For the present analysis, "misbehavior" is defined as a student-initiated classroom task. Violations of classroom rules, in other words, are viewed in terms of a goal and a set of operations necessary to achieve that goal. Such an approach underscores the student skills associated with classroom management and provides a useful framework for understanding student cooperation.

Since behavior tasks are student initiated, the goal is typically personal. During a lecture, for example, a student may want to relieve boredom, talk to a friend about tomorrow's football game, or embarrass the teacher. A student may have no malicious intent at all. From a teacher perspective, however, the public consequences rather than the goal of behavior task initiations are of greatest importance. Regardless of a student's motivation, success at a behavior task has an impact on cooperation of other group members in classroom activities. It is in this way that behavior tasks of students are connected to the classroom tasks of the teacher.

Achieving the goal of a behavior task depends on the student's ability to navigate the behavior task structure of the classroom, that is, to circumvent the enforcement system used by the teacher. Success at behavior tasks usually means that the violation is sustained for a reasonable period of time. Skillful, in contrast to merely troublesome, students usually "get away with" the violation, i.e., they are either not caught or are caught only after a long period of time has elapsed. A very skillful student can recruit other students and then quietly drop out of the task before the teacher becomes aware of the violation, thus letting his or her peers take the blame. Frequently, but not necessarily, accomplishing a behavior task can result in a disruption of classroom activities. In such cases, the magnitude of the disruption rather than the duration of the violation often defines the degree of success. If the move is skillful and the disruption large, getting caught is not always relevant. A student who can, for instance, ask a series of questions that are slightly off the topic and continue until the teacher tells the student to stop asking questions--a reaction that usually elicits an impassioned student soliloquy on the importance of curiosity for learning--"wins" regardless of consequences the teacher might invoke.

Recent descriptive studies have revealed the extent to which the general level of student cooperation is related to events that occur early in the formation of classroom structures (see Evertson & Anderson, Note 6; Smith & Geoffrey, 1968). Figure 2 presents a tentative model of the evolution of behavior task structures in classrooms. The model portrays a hypothesized trajectory of behavior task initiations over time, with a special focus on the "start up" period. The measure of behavior task initiations (Y axis) includes both frequency and the intensity or seriousness of the violations involved. Under average circumstances, the model predicts that, after a brief period of hesitancy or wariness, behavior task initiations increase fairly rapidly until a maximum, determined by the teacher's management skill, is achieved. At this point, initiations diminish until an equilibrium point is established around which the frequency and intensity of such initiations fluctuate. This equilibrium line defines the level of student cooperation for a particular classroom and represents the product of the prevailing norm of

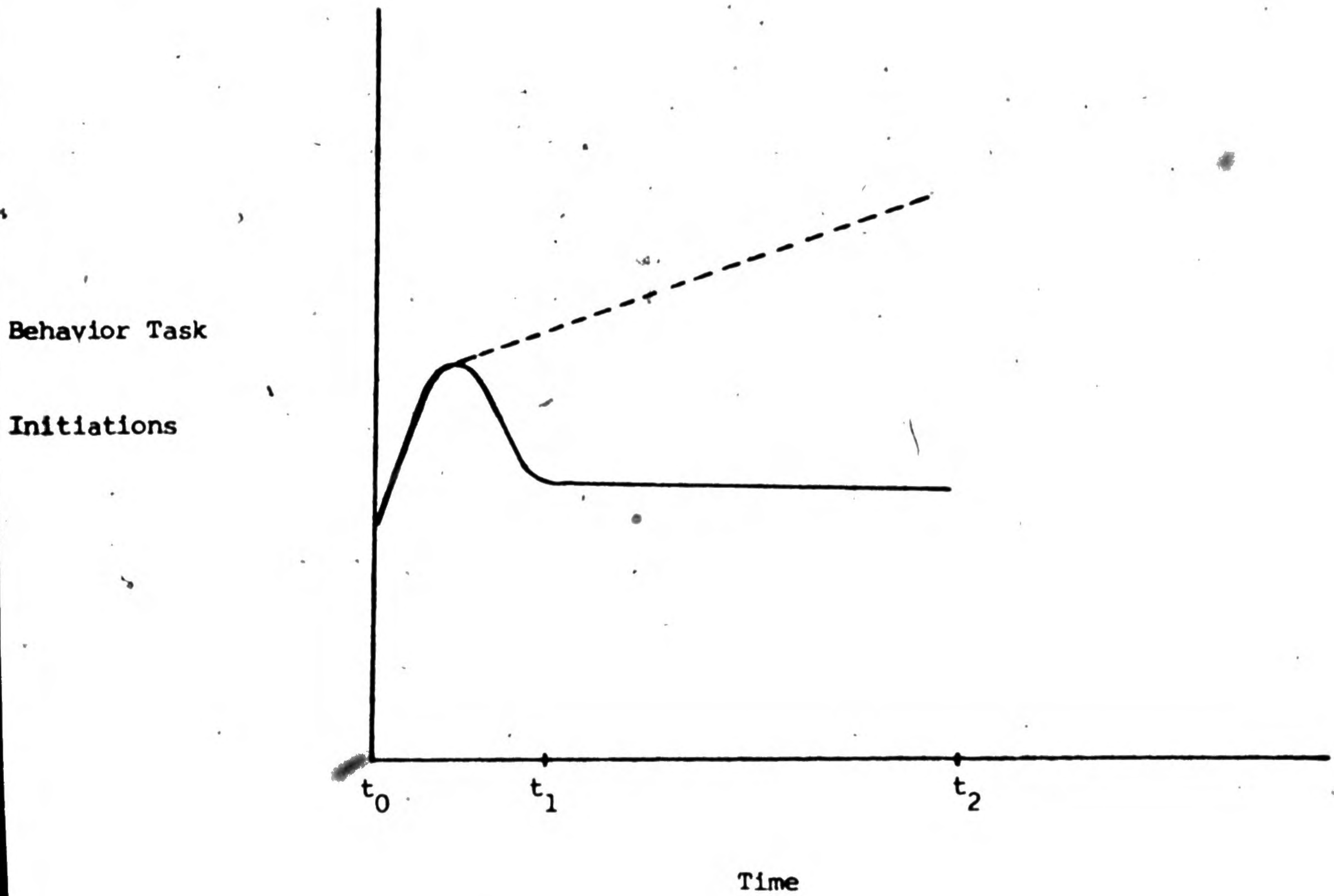

Figure 2: Hypothesized pattern of behavior task initiations over time in the formation of classroom routines (behavior task structures). (See text for explanation.)

rationality, teacher skill, and the aptitudes and inclinations of students. The amount of fluctuation around the equilibrium line depends upon a number of factors, including external interruptions, events in the school, and seasonal variations.

The time it takes to reach equilibrium (t_0 to t_1) and the shape of the "hump" vary with the management skills of the teacher and the behavior task skills of the students, or at least those students who specialize in such tasks. Teachers who exhibit the kinds of management skills identified by Kounin (1970)--withitness, overlap, group focus, and movement management--are usually able to deal successfully with behavior tasks. Success for the teacher in this context is defined by an eventual decrease in the frequency and success rates for behavior task initiations to a level consistent, to some degree at least , with the teacher's preferences and the situationally-defined norms for acceptable student conduct.

A key dimension of the management skills Kounin has identified is <u>timing</u>. At one level this means that successful managers appear to be able to recognize behavior task initiations immediately and intervene early (e.g., move toward a region of possible problems). Early intervention has the advantage of neutralizing a behavior task initiation before peer-granted rewards can be delivered and before public consequences occur. Early intervention also demonstrates to students the teacher's tactical skill. In addition to the timing of interventions, successful managers also appear to time the duration of activity segments and contacts with individual students to suit the demands of managing the total group. They are able, in other words, to adjust the flow of classroom activities to fit immediate circumstances. Timing, of course, does not guarantee success. Facing a group of students who have a low inclination to participate in classroom activities and who are proficient in behavior tasks can challenge the skills of any teacher.

The dashed line in the model predicts that if the teacher fails to manage the early behavior task initiations, the frequency of initiations will continue to rise and, importantly, more students will participate until the class is eventually "lost" for the semester. In a "lost" class, securing cooperation in any activity is virtually impossible (see Wegmann, 1976). Except in extreme cases, failure to establish a behavior task structure usually results from a lack of those management skills necessary to anticipate consequences and intervene early. It would also seem, however, that students need to know that a teacher is willing to be a teacher, that is, to do what has to be done to manage the classroom group. There is a teacher role in classrooms and students expect adults assigned to that role to fulfill its responsibilities (Nash, 1976). A teacher may, therefore, be required to behave in ways incongruent with personal preferences in order to meet the immediate demands of managing a group. Detailed process studies of two alternative schools provide especially strong verification of this principle (Center for New Schools, 1972; Moore, 1978). Despite formal mechanisms for student participation in governing these schools, a large majority of students tended to relegate to teachers the responsibility for formulating rules and enforcing them. Moreover, students tended to wait for teachers to signal the beginning of formal classroom activities. In sum, cooperation at a group level is not automatic, but depends on teacher skill and willingness to act.

The model further stipulates that the equilibrium line (t_1 to t_2) is maintained until some event signals a possible change in the behavior task structure of the classroom. The "hump" is repeated, for example, when a student teacher begins to take over a class from a cooperating teacher. Presumably a major change in activity would also be followed by an increase in the frequency and intensity of behavior task initiations. Gump (Note 7) found, for instance, that the amount of teacher structuring and dealing with deviant behavior increased during transitions between activities, suggesting that behavior task initiations are higher during these periods. Similarly, Tikunoff and Ward (Note 5) reported that the amount of teacher sanctioning increased after interruptions and during the introduction of new activities.

In information processing terms, behavior task initiations can be interpreted as part of an overall effort by students to understand a complex environment by rendering it predictable (Schank & Abelson, 1977). Early initiations serve to reveal the structure of the classroom and continue at a maintenance level to enable students to monitor the system. In this light, behavior task initiations are an indigenous feature of classrooms engendered by the complexity of the environment. Misbehavior will occur, therefore, in all classrooms, and a major part of the technology of teaching in classrooms must be defined in terms of the management of behavior task structures.

Characteristics of Activities and Teacher Decision Making

Research in the ecological tradition has documented that the behavior of students is associated with the structure of individual classroom activities. Gump (Note 7), for instance, found that student involvement was lower for self-paced activities than for externally-paced activities. Involvement was also lower in whole-class recitations than in small teacher-led groups. Recent studies in this tradition have attempted to identify the characteristics of activities that account for these differences in student involvement. Kounin and his associates (Kounin & Gump, 1974; Kounin & Doyle, 1975) have provided evidence that characteristics of the signal system of lessons (i.e., information and/or materials that guide the sequence of behavior) rather than the format of an activity (seatwork, recitation, etc.) affect student involvement. Lessons with a continuous signal input, insulation of participants from distracting signals, and low intrusiveness from the behavior of participants had high involvement. Thus, seatwork involving individual construction had higher involvement than seatwork involving group construction in which participants had to share materials. Similarly, in a whole-class setting, listening to a single, continuous source (teacher or record) had higher involvement than a group discussion in which both the teacher and students were sources of information.

From a different perspective, student participation would seem to be related to the information processing demands of the academic tasks embedded in classroom activities. In high demand situations (e.g., inquiry classes), not all students can participate because task accomplishment is often limited to high ability students. In addition, task demands can influence the willingness of students, regardless of ability, to cooperate. As indicated earlier, Davis and McKnight (1976) reported that high ability junior high school students actively resisted (i.e., refused to cooperate with) an attempt to increase the demands of academic tasks in a mathematics course. Along similar lines, Wilson (1976) reported that teachers in an alternative high school "were hampered in inquiry-teaching strategies" because students would not readily cooperate until the ambiguity inherent in such procedures was reduced.

Studies such as these suggest that student cooperation depends in part on the complexity of the activities being carried out in the classroom. Classroom structures that involve fragmentation of the group into smaller units for different activities increase multidimensionality and simultaneity and hence place special demands on withitness and overlap. For example, dividing a class of sixth graders into groups of four to rotate through seven learning stations to conduct experiments in electricity would be very difficult to manage unless students were especially cooperative and proficient in working independently. Similarly, activities that have a slow pace and involve only one student at a time--such as discussions using higher order questions--can increase problems of group focus and movement management and thus be practical only if students are knowledgeable and patient and the teacher is a skilled manager (Doyle & Ponder, 1975). Finally, forms of responding to students that localize teacher attention--such as proximity and continuous eye contact--are likely to reduce awareness and group focus and thus intensify management demands (Doyle, 1977b).

It would seem to follow that the activities teachers select and the way they allocate attention and use space, time, and resources in classrooms are influenced by the demands of a particular classroom environment (see Abrahamson, Note 8; Doyle, 1979; Westbury, 1973; Woods, 1977). Potter (Note 9, p. 87) describes an interesting example of this aspect of teacher decision making in her study of student participation. She found that teachers, when calling on non-volunteers, typically chose students who had frequently volunteered in the past and usually gave correct answers. This way of selecting students to respond appeared to be based on the need to maintain the flow of classroom activities.

From a more general perspective, the study of classroom effects raises some intriguing questions about the combination of circumstances that produces the classroom processes observed to be associated with high levels of student achievement. For instance, what makes it possible for a teacher to move more rapidly through a curriculum and thus increase the amount of knowledge students acquire (Good, Grouws, & Beckerman, 1978). Since a more rapid pace increases variance in achievement among students of different abilities (Arlin & Westbury, 1976; Barr, 1974), is it necessary that classrooms with a rapid pace be more homogeneous in ability? If not, what other actions must a teacher take to compensate for the effect of pace on variance? To what extent does the general ability level of a particular group of students and their overall inclination to engage in academic activities allow, or even force, a teacher to move rapidly? How many students of lower ability and inclination can be included in the group before maintaining a rapid pace becomes exceptionally difficult? In what ways do management skills influence the curriculum pace the teacher is able to achieve (Arlin, in press)? The use of class mean scores in most studies of teaching effectiveness masks information relevant to these questions about the conditions associated with effective teaching. It is often difficult to know, therefore, how to use results of such research. Simply telling a teacher to increase the pace of the curriculum may have disastrous consequences in a particular situation. Long-term studies of the evolution of academic and behavioral structures in classrooms (see Evertson & Anderson, Note 6) are necessary, therefore, before data on teaching effectiveness can be fully understood and applied.

Implications

In conclusion, an attempt is made to summarize some of the implications of this analysis for interpreting research and making decisions about training and intervention.

In interpreting teaching research, it would seem important to view teacher behaviors as signals of task demands in classrooms. Teacher expressions of clarity, enthusiasm, and high academic expectations, and teaching practices such as a rapid curriculum pace, specific questions, contingent praise and criticism, and equal distribution of response opportunities would all seem to signal that task demands are operating in a classroom--that the teacher is serious and likely to hold students accountable for academic performance. Similarly a teacher who is able to establish behavior task structures which can be circumvented by only the most skilled students are also likely to require conformity to academic tasks. Such an analysis ties teaching method with classroom management in ways that are seldom done in the literature on teaching.

At the same time, it is important to recognize student effects in interpreting process-product studies. In a recent report Metz (Note 10) gave naturalistic descriptions of processes in junior high school low and high ability tracks. She found that students in high tracks "expected to be treated as junior partners" (p. 3). They valued classroom discussions of content and expected their answers to be taken seriously. They also demanded reasons for actions and required fewer reprimands and directions to engage in activities. When they did challenge the teacher, they often did so in intellectual and academic ways. Students in lower tracks were more restless and less cooperative. They challenged the teacher in nonacademic ways by teasing and disrupting routines and were more persistent in engaging in misbehavior. In such tracks, order had to be established continuously, and the pace of academic activities was slow. High tracks, in other words, were essentially academic settings; low tracks were dominated by management and misbehavior. There are two striking features of Metz's descriptions. First, the <u>same</u> teachers were observed in both high and low tracks. Indeed, similarities among different teachers within tracks was greater than those for the same teacher across tracks. Second, these descriptions of high and low tracks parallel in many ways descriptions of effective and ineffective treatment conditions in teaching effectiveness studies.

In many cases it would seem appropriate to reverse the direction of causality in interpreting many teaching effectiveness results. For example, positive correlations between teacher acceptance of student responses and achievement, and negative correlations between teacher criticism and achievement are routinely seen as evidence for the effectiveness of these two 'treatments.' If student effects are considered, however, the interpretations are quite different: students who score high on achievement tests also give answers in class that the teacher can accept, and students who score low on achievement tests behave in classrooms in ways that elicit teacher criticism. This is not intended to suggest that there are no teacher effects. The analysis does urge caution in interpreting correlational data concerning relationships between processes and outcomes.

The analysis of classroom tasks also has important implications for the content of teacher education. In addition to preparation in subject matter and teaching methods, beginning teachers must be able to manage the multiple demands of the classroom environment. These are not, however, discrete areas of skill. Teaching in classrooms requires that teachers learn to translate subject matter into classroom activities and think about method in terms of time and sequence. Teachers must then be able to carry out activities in classrooms, to monitor classroom processes and adjust the timing of events. To do this successfully, a teacher must have a basic core of knowledge about classrooms and a fundamental understanding of how classrooms work. From this perspective, teaching is not simply a matter of following prescriptions. It is, rather, a cognitive process of the highest order. How teachers think about classrooms is not only shaped by classroom experience but also influences the way they behave in this environment. Understanding the distinctive properties of classroom environments must become, therefore, a major component of teacher preparation.

Finally, the approach developed here provides a basis for more informed interventions into classrooms. Two examples will illustrate this point. First, attempts to provide teachers with feedback concerning their classroom performance are often based on external models of teaching adequacy. If, however, observed teacher behavior is viewed as an adjustment to the demands of securing cooperation of a group in classroom activities, then recommendations for change must be made cautiously. A teacher's physical position in the classroom for instance, may depend upon the location of centers of high behavior task initiations or the problems of seeing the total group. Location can also signal students that a teacher is monitoring behavior or that an activity is being initiated (e.g., a transition). Any change in position to increase the amount of teacher interaction with particular students can disrupt these processes and thus have ramifications for general classroom management. It is likely that the ability to use feedback or even reduce the disruptive effects of feedback is dependent on a teacher's skills in accomplishing classroom tasks (Kepler, Note 11).

Second, attempts to change curriculum or organizational arrangements for teaching need to be understood from the perspective of classroom tasks. At an operational level, a change in curriculum is a change in activities. The introduction of innovations is likely to increase the frequency and intensity of behavior task initiations and thus produce high management demands for teachers. Implementation involves, therefore, more than simply knowing how to use the innovation. It also requires skill in securing cooperation of students in a new set of activities. Since many innovations are not designed on the basis of classroom knowledge, some may be very difficult to implement. It is understandable, then, that more innovations are proposed than implemented. Indeed, teacher resistance may often be a realistic reaction to many innovation schemes (Doyle & Ponder, 1977/78).

Some may argue that the study of classrooms is misdirected since these environments are soon to be replaced by more scientifically rational modes of instruction. Such changes may take place, but I must call attention to the fact that the classroom has been a remarkably persistent way of organizing teaching and learning in schools, despite equally persistent claims that it is obsolete. I am also impressed that the classroom is in many ways ideally suited to the institutional purposes and demands of common schooling, i.e., educating large numbers of students at the same time. What is needed, even if one's primary goal is improvement, is an understanding of how classrooms work and how changes in classroom architecture and routines affect teachers and students. Only then will it be possible to comprehend the possibilities and consequences of schooling.

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