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ABSTRACT

This report contains a description of the conceptual background and methodology for a study concerning how academic tasks are managed in senior high school classrooms. This high school study is Phase 2 of the Managing Academic Tasks (MAT) study. The MAT study is focused on understanding how curriculum experiences are shaped by the classroom environment and how teachers can enhance the quality of academic work at the secondary level. Special emphasis is given to classroom tasks involving comprehension and higher level cognitive processes, especially tasks requiring students to make decisions about how to use their knowledge and skills in particular situations. This report incorporates the experience of the earlier junior high school study and contains a description of (1) the intellectual foundations of the data collection; (2) the design of the study and the classes that are being observed; and (3) the methods used for gathering and analyzing data. Appendices contain illustrative materials, including (1) excerpts from the Topic List for MAT teachers, Grades 7 and 8; (2) excepts from the Task List for Grades 7 and 8; (3) illustrations of Task Analyses; and (4) an example of a Task System Summary. (PN)

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Managing Academic Tasks in High School Science and English Classes: Background and Methods

This report contains a description of the conceptual background and methodology for a study of how academic tasks are managed in senior high school classrooms. This high school study is Phase II of the Managing Academic Tasks (MAT) study being conducted by the staff of the Research on Classroom Learning and Teaching (RCLT) Program at the Research and Development Center for Teacher Education. Building on a long and distinguished line of Center research on teaching effectiveness and classroom management, the MAT study is focused on understanding how curriculum experiences are shaped by the classroom environment and how teachers can enhance the quality of academic work at the secondary level. Special emphasis in this study is being given to classroom tasks involving comprehension and higher level cognitive processes, that is, tasks requiring students to make decisions about how to use their knowledge and skills in particular situations. Phase I of the MAT study was conducted at the junior high school level. Data for Phase I were gathered for a 6-week period during the Spring of 1983 in two science, two English, and two mathematics classes and for 10 weeks during the Fall of 1983 in a combined social studies and English class for high ability students (for details, see Doyle, Sanford, Clements, French, & Emmer, 1983). Information about academic tasks was obtained through daily classroom observations, examination of students' work after it had been graded by the teacher, and interviews with teachers and students.

For Phase II of the MAT study attention shifted to the high school. This move to high school was of interest to the RCLT staff for two reasons. First, with few exceptions (e.g., Sirotnik, 1982), little

classroom research has been done in high schools. A need exists, therefore, to learn more about teaching processes at this level. Second, national interest has recently focused on students' achievement in high schools and especially on the acquisition of reasoning ability and higher order thinking skills (see Adler, 1982; Boyer, 1983; The College Board, 1983). This concern for higher level thinking is consistent with the general focus of the MAT research program.

Data for Phase II of the MAT are being collected in one English and two science classrooms. This report contains a description of (a) the intellectual foundations of this data collection effort; (b) the design of the study and the classes that are being observed; and (c) the methods used for gathering and analyzing data. Appendices containing illustrative material are also included. Given common themes and objectives, there is considerable overlap in concepts and design between Phase I and Phase II of the MAT study. Nevertheless, this report is necessary to reflect what has been learned from the experience of the junior high school study and to account for the distinctive character of high school classes.

Background and Rationale

The study of effective classroom practices has recently led researchers to examine the nature of the work students accomplish in classrooms and the opportunities to learn that this work provides (see Doyle, 1983; Doyle & Carter, 1984; Erickson, 1982; Good, 1983). The MAT study was designed to extend this line of inquiry by focusing on the forms the curriculum takes in classrooms and on the interpersonal, managerial, and psychological processes associated with these different curricular forms. This section contains a general summary of research

on classroom work with specific reference to the concept of "academic task."

The Quality of Academic Work in Secondary Schools

Secondary instruction is expected to provide students with opportunities to reason, to understand complex concepts, to go beyond basic skills and memory work. A number of studies of classrooms in schools, however, suggests that opportunities for practicing higher level operations in schools may be scarce. Boyer (1983), Stake and Easley (1978), Ward and Tikunoff (1982), and others, have reported observing a narrow range of routine activities affording little opportunity for most students to master challenging work or important concepts. Goodlad (1984), in particular, has pointed to the passivity of students, the routinized formats, and the paucity of real problem solving opportunities in high school classes and has called for major reforms in the way the high school curriculum is handled.

Another current line of research, focusing mainly on science and mathematics instruction, suggests that in many classrooms students have little understanding of their work and the content (see Hackling & Treagust, 1984; Helm & Novak, 1983; Tasker, 1981). There is evidence that class work is often designed and managed in such a way that it masks students' lack of understanding of concepts, because students are not required to do comprehension-level tasks. For example, an experiment by Coulter, Williams, and Schultz (1981) supports their contention that in process-oriented science classes, teachers' use of tests students can complete through recall and algorithms hides the fact that many students do not really understand the targeted cognitive processes. Davis (1983) reviews recent research on mathematics learning

to present an excellent case that our current practices of teaching mathematics only as routine algorithms (i.e., using tasks that require students only to produce correct answers in routine ways) results in superficial or inaccurate understanding and prevents diagnosis of students' understanding. Stewart and Dale (1981) also demonstrate how students' success at routine genetics problems masks lack of understanding of critical concepts.

Research on Academic Tasks

Recently some research has begun to focus on academic work in different secondary school subjects, using the academic task framework proposed by Doyle (1983). This line of research is built on the assumption that students encounter content in the form of assignments for which they are held accountable. The nature of the work and how it is managed by teachers determines in large measure what students attend to and how they process information, thus what skills they practice, what kind of performance they are evaluated on, and in the final analysis, what they learn.

Studies in this vein to date have demonstrated that while much secondary school academic work is routine, familiar to students and thus easily conducted by teachers, managing comprehension-level tasks (i.e., work intended to require students to go beyond rote learning, to organize and apply what they know, to demonstrate understanding of a principle, or to use knowledge flexibly) is complex, making maintenance of smooth activity flow and steady student engagement very difficult (Doyle, in press; Doyle et al., 1983). Furthermore, tasks that are announced or initiated as comprehension-level assignments may during the course of classroom events be accomplished by means other than what

teachers originally intended. Doyle and Carter (1984) describe how writing assignments in English classes they studied tended to get narrowed, more predictable, and less demanding of students' creative efforts across several days of work in class. In response to student questions and pressures to maintain order and activity flow, teachers gave students prompts, clarified and/or changed requirements, and softened accountability by using extra credit points and extension of time limits. In addition, in grading writing assignments, teachers tended to grade routine grammar elements more stringently than content of compositions.

In a study of 11 junior high science classes by Mitman, Mergendoller, Packer, and Marchman (1984), the authors noted that only a very small proportion of observed tasks required higher level, creative or expressive skills and that on tasks having the highest level of accountability (i.e., tests) problem levels were generally even lower than on worksheets and other assignments. In addition, nontest tasks consisting of worksheets and lab assignments were very often graded not for accuracy but only for completion. The authors speculated about the effects of this management strategy:

> One would predict that they [students] came to value accurate performance on exams foremost, followed by the most expedient methods to producing lab sheets and worksheets that appeared complete. (page 4.36)

Mitman et al. (1984) emphasize commonalities in task types and management strategies across their 11 teachers. Differences where noted seem usually to be tied to differences in topics or time of year. In contrast, recent work by Doyle, Sanford, and their colleagues (Doyle et

al., 1983; Sanford, 1984) suggests that classes vary greatly not only in type of tasks that are attempted or eventually accomplished, but also in the nature of task systems in place. Some systems emphasize meaning, relationships among different tasks and instruction; others do not. This difference would appear to have some impact on how students complete their work (e.g., whether they apply what they learned in a previous assignment to a current task) and how they understand it. Some task systems feature large numbers of short term, separate, and even interchangeable tasks. Such a system is predictable, routine, and easy to manage. Other systems are characterized by longer term tasks or close linkages across tasks, requiring more careful planning and management. In some systems comprehension-level tasks are prominent; in others such tasks may be almost non-existent, or peripheral.

This line of inquiry clearly indicates that a richer understanding of academic work in secondary classrooms would be a valuable resource for instructional improvement. To see how such an understanding might be generated, we now turn more specifically to the intellectual framework of the MAT study.

Academic Tasks

The central construct for the MAT analysis is the "academic task." This construct, derived from recent work in cognitive psychology and cognitive anthropology (see Doyle, 1983; Laboratory of Comparative Human Cognition, 1978), makes it possible to peel back some of the layers of the curriculum-as-document to examine the curriculum-in-use, that is, the curriculum as a daily event in classrooms.

The label "academic task" refers to the form that a segment of the curriculum takes in a classroom. A description of a task is essentially

a description of what students are required to do with subject matter for a particular period of time in a class. The description of an academic task begins with the specifications for the product students are to generate, such as words and blanks on a worksheet or an essay which is to contain a comparison of two characters in a story. In addition, there are a set of conditions under which the product is to be generated that shape the precise nature of a task. These conditions usually consist of (a) implicit or explicit information about the operations students are to use in producing the product such as copying words off a list on the chalkboard, remembering words from a previous lesson or a list that has to be memorized, applying a rule (such as, "plural nouns use plural verbs"), or using one's imagination to make up "creative" answers; (b) resources in the form of information from a textbook, from fellow students, from other materials, or from teacher feedback; and (c) information about the significance or "weight" of the task in the grading system of the class. The meaning of a task is also affected by its familiarity. When a task is congruent with other tasks in a class, then students have a considerable amount of relevant experience to use in interpreting and accomplishing the task.

The basic components of the academic task model which underlies the MAT study can be summarized as follows:

1. Students are guided in processing information in classrooms by the tasks they are required to accomplish with subject matter. Whether information from the teacher (or from textbooks or other resources) is attended to or processed by students depends upon its relation to the academic tasks which students are working on.

2. A task is defined by a goal, a set of operations to achieve the goal, and resources available in the situation.

3. Four broad types of academic tasks can be distinguished on the basis of the operations necessary for accomplishment: (a) memory tasks in which information previously encountered must be reproduced; (b) routine tasks in which a predictable procedure or algorithm (e.g., addition of fractions) previously learned must be applied to standard cases; (c) opinion tasks in which a personal preference or attitude must be expressed; and (d) understanding tasks in which transformed versions of information must be recognized as equivalent, inferences must be drawn from available information, or complex higher order operations such as analysis or problem solving must be used.

4. In classrooms, academic tasks are defined by (a) the nature of the products teachers accept and (b) the operations allowed and the resources available for generating these products. For example, the task of producing a composition by following a model provided by the teacher or a fellow student is obviously different from a task in which an original composition must be generated without such models.

5. Academic tasks in classrooms, because they are embedded in an evaluation system, are accomplished under conditions of ambiguity and risk. Ambiguity refers to the extent to which a precise formula for generating a product can be defined. (This is not ambiguity which results from a lack of teacher clarity; rather, it is an inherent property of academic work.) Risk refers to the stringency of the evaluation criteria and the likelihood that these criteria can be met on a given occasion. A task of memorizing 50 lines of poetry is low on ambiguity--one clearly knows what has to be learned--but high in risk

(if accountability is strict) because of the factors that might interfere with a successful recitation on a given occasion. Attempts by students and by teachers to manage ambiguity and risk either by increasing explicitness or by modifying accountability affect the course of task accomplishment and the character of a task itself. Especially for higher-level cognitive operations, tasks often change as teachers and students struggle with inherent demands (see Carter & Doyle, 1982).

Cognitive Level of Academic Tasks

Attention in the MAT analysis is being focused on the overall task systems that operate in the classes as well as the character of individual tasks. In addition, the study was designed with a special emphasis on academic tasks involving higher-level cognitive processes. Some extension of the basic task model outlined above is necessary to clarify the meaning of this emphasis on higher cognitive processes.

The cognitive level of a task is defined internally by the cognitive processes students use to accomplish it. Because these processes cannot be observed directly, it is necessary to infer the cognitive operations students use from a thorough description of the task itself, that is, the product, the operations specified by the teacher and those allowed to students in the setting, and the resources available to students while they are working on the task. In other words, an attempt is made to construct from observations a model to explain task accomplishment in a particular situation. A task involving higher cognitive processes is a task that students appear to accomplish with higher-level cognitive operations. Although it is impossible to verify directly whether students actually used these operations on a particular occasion, research in cognitive psychology indicates that a

model of a task goes a long way toward providing a model of information processing (see Dawes, 1975).

For purposes of this study, higher cognitive processes are defined as those requiring executive-level decision making, that is, decisions about how to use knowledge and skills in particular circumstances (see Doyle, 1983). The emphasis, in other words, is on the flexibility of students' knowledge and skills. In its most basic form, executive decision making is involved in recognizing transformed versions of information or algorithms previously encountered. At more advanced levels executive processes include such operations as (a) selecting an algorithm or a combination of algorithms to solve a word problem in math, (b) drawing inferences from information given to formulate new propositions, or (c) planning goal structures for a writing assignment.

Greeno (1983) has provided a useful example of a higher-level cognitive process, namely, the process of constructing a semantic representation of a word problem in mathematics. He summarized evidence suggesting that expert problem solvers are able to recognize or construct patterns among quantities identified in a problem text. These patterns come together to form a semantic model or representation of the problem. This semantic representation is then used to select a formal model that specifies the operators or equations to use in solving the problem. Greeno (1983) emphasizes that:

> [Semantic representations] are not the same as the formal structures of mathematical relations or the equations of physics. What we have found in all the analyses of problem solving is that successful students form intermediate representations that include relations among the quantities in a problem. Formal methods of

computation may be used in finding problem answers, for example, the formula for combining resistances in a parallel circuit may be retrieved and used to compute the equivalent resistance for the components. But the patterns of quantities are not the same as the formulas, and the research findings are consistent in supporting the conclusion that the relational patterns play a critical role in the processes of problem solving. (p. 7)

One way to visualize the analytical target of the MAT study is to think of a task as a definition of a gap in information that students are to cross with a cognitive act. Small gaps can be crossed by reproducing information previously encountered or by recalling and using a reliable algorithm. Larger gaps required that a student organize the task environment and connect what is known to the particular conditions of the task. One of the special purposes of the MAT study is to examine closely how these gaps are defined and maintained or adjusted by teachers and students in classroom environments. Two additional points are in order. First, no attempt has been made at this stage of the MAT study to define a complete taxonomy of higher cognitive processes that might appear in academic tasks. There is some reason to argue that a generic taxonomy, that is, one separated from specific subject matter operations, is not especially informative when one is studying academic work (see Doyle, 1983). Moreover, an effort to organize knowledge about the cognitive level of tasks that actually occur in classrooms is best done after many of these tasks have been examined. Second, the emphasis on higher processes is not exclusive nor is it intended to suggest that all classroom tasks should be conducted at this level. Rather, this special focus is based on a recognition that higher order processes are

generally considered to be an important part of the curriculum, especially in secondary schools. In addition evidence from cognitive science (see Doyle, 1983) suggests that factual and algorithmic knowledge lacks both durability and utility if it is not embedded in executive decision processes.

The Problem of Outcomes

The richness of the MAT data would seem to provide an opportunity to ask interesting questions about classroom effects on students' cognitions. It is reasonable, therefore, to push the analysis toward questions of the effects of tasks on the enduring knowledge and skills students acquire (e.g., Do the students understand ratios and can they perform operations with ratios?) and on their evolving conceptions of content (e.g., What do they think mathematics is?).

There are, however, at least two major problems involved in a direct study of task-outcome relationships. First, outcomes of a specific task need to be measured by a test keyed directly to that task. General achievement tests are not informative in such instances. Second, a pre-assessment is essential if effects are to be attributed to a particular task experience rather than to prior knowledge or general ability.

A model of how to go about measuring the achievement associated with particular instructional experiences has been provided by researchers interested in conceptual change (see Eaton, Anderson, & Smith, 1984; Erlwanger, 1975; Nussbaum & Novick, 1982; Posner & Strike, 1983; Stewart, 1983). In this work, a very specific concept, process or operation in mathematics or science (e.g., how light enables us to see or how diffusion occurs) is identified. Clinical interviews with

individual students are then used to map preconceptions prior to instruction on the topic and to assess outcomes after instruction has occurred. This close look at knowledge, instruction, and learning makes it possible to obtain a reasonably clear picture of specific instructional effects.

It is difficult to apply this work on conceptual change to the MAT data. Many different tasks are observed in classes, and pre-assessment under these conditions is difficult.

During the Spring data collection for Phase I in junior high schools, teachers and students were interviewed concerning their perceptions and interpretations of the tasks they accomplished. These interviews were conducted after the observation period was over in order to avoid intruding into the task system in the classes. No attempt was made here to give a complete account of the views of the participants in the study. Rather, the purpose of the interviews was to learn how the teacher and students understood the overall task system in a class as well as the place of individual tasks in that system. It was hoped that this information would throw some light on the core problem of defining the cognitive level of tasks accomplished in the classes.

In conjunction with the Fall 1983 data collection for Phase I and in planning for the high school phase, the MAT staff attempted to design interview procedures to gather more detailed information about student perceptions of specific academic tasks. Particular attention was given to obtaining information about a teacher's plans for a specific unit prior to observations and then designing beginning-of-unit and end-of-unit interviews. These revised procedures make it possible to

generate some preliminary insights into potential relationships between tasks and outcomes.

In t. 1, however, the question of outcomes in the MAT is handled indirectly by focusing on the opportunities provided within tasks for students to practice various cognitive processes. Following the logic of "academic learning time" (see Fisher, Berliner, Filby, Marliave, Cahen, & Dishaw, 1980), it was argued that such opportunities are likely to be associated with student achievement. Nevertheless, direct connections between tasks and outcomes, as well as individual differences in achievement, are not a focus of the MAT.

Design and Methodology

Structure and Objectives of Phase II

Phase II of the MAT extends the work begun in junior high schools through intensive case studies of work in a small number of high school English and science classrooms. Propositions about classroom tasks suggested by results of the junior high study will be reexamined in the high school setting, where more emphasis is placed on higher order tasks, learning of abstract concepts, and increasing student independence. As in the junior high study, the purpose of Phase II of the MAT is to describe how the content of secondary curriculum is translated into tasks for students, examine the resulting opportunities for students to practice different cognitive processes, and acquire greater understanding of how experienced teachers formulate and conduct tasks in classrooms.

In the Fall and Winter of 1984, data are being collected in three classes, one English and two biology, taught by three experienced teachers with reputations for effectiveness. One class of each teacher

is observed during the first week of school and subsequently throughout the conduct of a unit of work extending 4 to 6 weeks during the Fall-Winter, 1984 term. In addition to classroom narrative records, data include interviews with teachers and selected students, instructional materials, and students' graded assignments and tests.

Analysis of these data will focus on individual tasks and task systems operating in each class. First, tasks will be identified and described with regard to assignment requirements (both as initially announced and as subsequently altered); resources such as instruction, feedback, prompts, or background materials and texts; accountability; classroom events associated with task accomplishment; and cognitive demands of tasks. Objectives of this analysis will be to generate insights about the creation and accomplishment of different kinds of academic tasks in high school. The high school data analysis provides opportunities to explore further some themes and hypotheses emerging from the MAT Junior High School phase: semantically tied versus skill-based task systems; accountability and credit variations across different types of tasks; task familiarity and assembly requirements; and small gap versus large gap task systems.

Sample and Selection Procedures

Data for Phase II is being collected in English and biology classes because these subjects are of major importance in the curriculum and are content areas of national concern. In addition, they feature types of academic tasks about which a considerable body of cognitive research is beginning to accumulate (see Doyle, 1983; Novak, 1984). Finally, contrasts among tasks in these diverse disciplines will be useful for learning about the nature and management of academic work.

Because of the intensive data collection and analysis required to trace academic tasks (see Carter & Doyle, 1982; Doyle et al., 1983), special care is taken to select teachers who have good classroom management skills and who use a variety of instructional tasks in their classes. During Spring, 1984, nominations of teachers were solicited from three sources: school district instructional coordinators in science and English, principals of high schools in the district, and University supervisors of student teaching programs in secondary science and English. In formulating their nominations, nominators were asked to consider three areas: (a) indicators that the teachers are effective in teaching the content of the curriculum; (b) evidence that the teachers are proficient in organizing and managing classroom activities; and (c) evidence that the teachers attempt to use a wide range of classroom tasks, including some addressing higher order objectives. These guidelines were designed to help insure that the teachers nominated would fall within the upper range of effectiveness, have few management problems which might interfere with the description and analysis of academic tasks, offer a variety of classroom tasks, and be generally committed to the advancement of learning and teaching in their curricular areas. Teachers who were nominated by more than one of the three sources were contacted to solicit their interests in participating in the study.

Teachers chosen for further consideration were visited by RCLT Project staff during May, 1984. Staff members talked with the teachers about their program of academic work and observed one or more of their classes. The purpose of these observations was to become familiar with the events and processes in the teachers' classes and verify that the

teachers were effective in managing academic work and offered a range of academic tasks for their students.

In each subject area, final selection of classes for the case studies was based on indications of teachers' instructional effectiveness and on the kinds of academic tasks they used, as well as feasibility of observation schedules and contrasts between teachers' approaches. In selecting an English teacher, special attention was given to the teacher's treatment of curriculum goals in the area of composition. In biology classes, emphasis was placed on selecting teachers who ttempted some classroom tasks with objectives other than knowledge/recall and who included so.. long-term as well as short-term assignments in their task systems. The three teachers who were selected for the study will receive a $250 stipend for out-of-class time.

The students in these teachers' classes constitute the student sample for the study. Parents' permissions were obtained to examine students' completed and graded work and to interview them. Six to nine students from each class will be selected for interviews at least twice during data collection. Students for these interviews will be selected to provide several levels of success in accomplishing academic tasks and of participation in lessons and other interactions with the teacher.

The Case Study Classes and Content Units

Teacher 9's class is an honors section of first-year biology. There are 20 students in the class, including 7 freshmen and 13 sophomores; 12 of the students are females. The honors biology curriculum requires an emphasis on reasoning processes and independent study skills. Students' standardized achievement test scores from the previous year ranged from the 69th to the 99th percentile, with half of these students scoring in

the 90th percentile or above, and only one below the 75th. Teacher 9 is an experienced teacher who participated in the development of the school district's honors biology curriculum. She teaches chemistry in addition to biology.

Teacher 10's biology class, although designated an honors section, has a heterogeneous s composition. It is located in an integrated school with a reputation of excellence in science education. There are 26 students in the room, including 12 freshmen, 12 sophomores, and 2 juniors. Students' standardized reading and mathematics achievement test scores from the previous year range from below the 20th to the 99th percentile, with five students having math scores below the 75th percentile and nine with reading scores below this level. There are 15 females in the class, and the ethnic composition is as follows: American Black 5, African Black _, Anglo American 17, Spanish surname 2, Asian or Indian 1. Teacher 10 has is an experienced teacher and department chairperson. She participated in the design of the honors curriculum in the district.

In both science classes, a unit focusing on human genetics will be observed. Science educators consider genetics as fundamental to the secondary biology curriculum, and it is a topic that is relatively difficult for students to learn (Stewart, 1982). The stated goals of the honors curriculum include development of independent study skills and higher order cognitive processes. The units to be observed in both classes include a variety of assignments and activities and cover the topics of cell reproduction and self-perpetuation, including concepts pertinent to the nature of the genetic material, principles of heredity, genetic and environmental interactions, and evolutionary mechanisms.

Observations of the genetics unit in both classes affords an opportunity to study two teachers in two classes of contrasting student composition as they encounter tasks dealing with abstract concepts about which a considerable body of research on student learning exists (see Hackling & Treagust, 1984). In addition, this content unit includes value-ladened issues (e.g., genetic engineering) and complex problem solving (e.g., pedigree problems).

Teacher 11 has taught high school English for the past 8 years. He teaches both honors and regular classes at the sophomore and junior levels. His regular level junior English class is the focus of MAT observations. There are 25 students in this class (18 Anglo, 6 Mexican-American, and 1 Black). The students' standardized test scores range from the 20th percentile to the 80th percentile. The junior English curriculum, which Teacher 11 helped to develop, places a heavy emphasis on writing, although grammar, vocabulary, and literature are also allotted some time.

In the English class, at least three content units are being examined: a 2-week "descriptive essay" unit, a 2-week "argumentative/persuasive essay" unit, and a 2- or 3-week unit on "expressive writing." A 1-week grammar unit has also been observed, though it is not a focus of the research. Each of the three writing units represents an attempt to establish a system of work in which students' products, the procedures through which these products are to be produced, and the resources available to aid students, are highly structured and explicitly defined. However, the nature of the products, procedures, and resources differ from unit to unit, as do the instructional strategies through which the teacher presents the unit and

the organization of the subtasks which serve as components of the unit. Finally, the units themselves are linked together both in terms of content linkages and in terms of their place in the flow of work in the class.

Data Collection and Analysis Procedures

Overview of data collection. Data for the high school case studies are collected in two stages. The first stage consists of observations for the first week or weeks of the school year. These observations are designed to gather information about the basic structure of each class, requirements and procedures for routine tasks introduced at the beginning of the school year, and how the academic task system is installed. The second stage of data collection consists of daily observations of all academic tasks during the enactment of the target unit, inspection of curriculum materials and student products, two to three interviews with selected students, and two formal teacher interviews.

Observation procedures. Observer teams of two members will be assigned to observe teachers in each content area. Primary observers/analysts for the study are four senior researchers with experience in writing classroom narratives, namely, Doyle, Sanford, French, and Nespor. In addition, other staff members will assist in data collection and analysis as needed for the project. The staff of the RCLT Program has had extensive experience writing narrative records of observations in the junior high phase of the MAT as well as in elementary and junior high school classes for previous studies of classroom management.

During each observation, the observer is responsible for generating a narrative description of classroom events and circumstances affecting academic tasks in that teacher's class. Observers take rough notes in class and then dictate as soon as possible a complete narrative on tape. In addition, an audiotape recorder is used to obtain verbatim task-related statements made by the teacher or students. Typescripts of such statements are incorporated into the final narrative record. Typed copies of the dictated narratives are returned to observers for analysis.

In constructing the narrative records, observers concentrate primarily on information that defines the nature of students' products and the conditions under which they are produced. Such information includes teachers' formal directions (written or oral) for assignments; teachers' responses to students' questions about assignments; resources made available to students in the form of materials and references, models of finished products, and opportunities to share work with other students or to get interim feedback from the teacher; statements about grading policies, extra credit, and accountability; and remarks about the relationships among various aspects of work. In addition, observers keep a record of time and provide a running account of classroom events focusing on such dimensions as student participation and engagement (general estimates), teacher location and movement in the room, sources of student-initiated questions, and other indications of the flow of work in the classroom. Information concerning the physical setting of the classroom and location of students is also recorded. Finally, special attention in the high school study is given to feedback, that

is, all corrective teacher statements, oral or written, to students about their work in progress or on completed tasks.

Because of their major role in defining tasks, copies of assignment sheets, worksheets, textbooks, and other materials used by the teacher and students are collected. In addition, information on chalkboards, overhead transparencies, or posters in the room is copied. When necessary, observers ask teachers informally to clarify requirements or other information about tasks. In addition, observers obtain copies of materials given to students describing general classroom policies, procedures, and expectations.

Work that students complete is examined after it is graded by the teacher to ascertain what the students actually did in accomplishing a task and how the teacher actually evaluated their products. In particular, observers look for:

1. The correspondence between stated task requirements and the final products (i.e., what did the students do in comparison with what the teacher seemed to establish as criteria in the announced requirements);

2. Patterns of students' errors or areas of difficulty;

3. The focus and general character and specificity of written teacher feedback;

4. The grades students received; and

5. Any correspondence between prompts or models given by the teacher in class and the content of student products.

Observers record student grades and written teacher comments and make copies of important or potentially interesting assignments.

Teacher interviews. In addition to informal conversations on a regular basis, teachers are formally interviewed prior to the beginning of the target unit and at its conclusion. The purpose of the initial interview is to gain information about the teacher's intentions for the unit and the type of planning that has been done. The interview focuses on such themes as the following:

1. What revisions have been made in the unit since the last time you taught it and what factors were considered in making these revisions?

2. What specific purposes do you have in mind for the unit? What knowledge and skills do you expect students to gain from this unit? How do the purposes of the unit relate to the overall goals of the course?

3. How will students be evaluated for the unit? How will the grade for the unit be computed? How will grades for the unit be used to determine grades for the term?

4. What problems do you anticipate in conducting this unit (this task?)? How much whole-class instruction time have you planned for this unit? How much in-class time will be allocated for students to work on this unit? How much out-of-class time do you estimate they will need to complete the unit? Which concepts or parts of the unit do you expect students to be most successful with? Least successful with? Why?

The final interview will focus on the teacher's perceptions of how well the unit progressed and how successful the students were. Attention will be focused on specific tasks and specific students' performance to learn about how these teachers evaluate tasks and student learning in relationship to the tasks. In addition, using a lesson narrative or graded student papers, teachers will also be asked to

retrospect about their thinking with regard to giving feedback to students. Finally, observers will clarify, as necessary, the policies and procedures for academic work that were used during the course of observations. They will also obtain copies of grade records for the class and an explanation of the formula used for computing final grades for the unit.

Student interviews. Student interviews will be conducted to provide a perspective on how high school students view academic work and its accomplishment. The observers in each class will select six to nine students for interviews. Students of potential interest include: (a) those who frequently solicit information from the teacher which serves to clarify or alter the tasks; (b) those who are consistently successful in accomplishing work; (c) those who do not play active roles in classroom interaction but who accomplish work successfully; (d) those of high or low ability who appear to have difficulty doing the work; and (e) those who appear to accomplish tasks through strategies other than what is expected or intended by the teacher.

Students will be interviewed individually on at least two occasions with regard to specific tasks they have completed or are working on. Interviews are expected to last approximately 15 minutes each and will take place in a room near the classroom. The purpose of the interviews is to get information about:

1. How students define tasks and what relationships they perceive among related tasks;

2. Students' self-reports of how they accomplished tasks;

3. Students' affective reactions to their work (motivation, interest, relevance, feelings of success or failure); and

4. Assessment of students' understanding of the content of the tasks they have accomplished.

Students will be questioned about task requirements and objectives (e.g., "What did the teacher want?"), the time they devoted to working on tasks, resources they used, their perceptions of the importance of the tasks in terms of weight in the grading system, the function (content relationships) of the tasks in the unit or course as a whole. Questions will also probe students' interpretation and use of feedback that they received from the teacher about specific tasks.

Analysis Procedures

As narrative records and interviews are typed, observers/analysts begin a detailed analysis of the tasks seen in each class. Information obtained from in-class observations, instructional materials, student products, and informal and formal interviews of teachers and students are used to produc (a) a topic list, (b) a task list, (c) task analyses, (d) teacher/task system summaries, and (e) student case studies.

Topic lists. Topics or assignments for each class are listed in the order in which they occurred. On occasions when students' products are handed in to the teacher for summative grading, an asterisk (*) is placed beside the numbered item on the topic list. The topic list provides an overview of content instruction, tasks, and other activities accomplished in each class during the observation period. A sample topic list from Phase I of the MAT is included in Appendix A.

Task lists. Task lists contain a brief description of each task, the date on which it was completed, the number of sessions in which direct time was devoted to introducing or working on the task, and the

approximate time devoted to the task. In addition, tasks are classified as major as minor based on information from the narratives concerning the importance or weight assigned by the teacher to each task during the observation period. Appendix B, a task list from Phase I of the MAT, illustrates this phase of analysis.

Task analyses. Once tasks are identified, observer/analysts begin the process of describing the components of each task. Tasks that appear to involve higher cognitive processes are given special attention. Analysis of a task is accomplished by reading all of the narratives related to the task and examining related materials and student products. Many tasks, especially major ones, are accomplished over more than one class session and involve several episodes of content instruction or several closely related minor tasks.

Beginning with major tasks and using information from the narratives, instructional materials, student products, and teacher interviews, observer/analysts complete a detailed analysis of each task. The task analysis consists of the following components:

1. a general description or overview of the task and its place in the content unit and work system;

2. all requirements for the task, including any changes in the requirements during the time it was worked on;

3. an account of class time use on the tasks;

4. a description of all the resources and prompts that students appear to use in completing the task, including a description of content instruction;

5. a general account of "how it went" from initial assignment to turning in of the task, including major events, work flow, and student interactions about the task;

6. an analysis of the accountability aspects of the task, including teacher's comments about how the task would be graded, how the task and different aspects of the task actually were graded, and grades or credit received by individual students; and

7. an analysis of cognitive operations, both as the teacher intended (according to announcements, interview comments, and instructional materials) and as students appeared to use, in light of information collected about resources, classroom events, student products, and performance. Included in this section are summaries of students' reports of how they completed tasks, and their perception of difficulty of different aspects of the assignment.

Production of the task analyses provides a framework for identification and exploration of potential themes for future exploration and discussion. Thus, as an analyst sifts through classroom data to uncover the resources for a task, or tries to assess cognitive operations students were likely to have used in completing a task, insights about management of different kinds of tasks, about problems teachers have in conducting content instruction effectively, and about the impact individual students can have on class work begin to emerge. In addition, the process of task analysis calls attention to different patterns of relationships and linkages among tasks in the different classes in the sample. Appendix C contains two task analyses from the junior high MAT, chosen to illustrate analysis of different types of tasks.

Teacher/task system summaries. After describing the tasks observed in a class, each observer/analyst formulates general statements about the nature of the academic task system operating in the class for that time period. In the development of these general summaries, observers/analysts think of two levels of analysis: (a) the content itself and how it was represented in the tasks that the teacher and the students accomplished; and (b) how content was held in place in the classroom, that is, how prompts and accountability, etc., were handled to accomplish tasks. The resulting working documents provide descriptions of (a) how each of the teachers translated content into a system of class work, (b) the nature of the work students accomplished, and (c) some of the management or content issues that appeared to be salient in the class. When possible, types or categories of tasks are identified in each class and management of each type described, in an effort to facilitate generalizations across different classes and content areas. Maps or charts are prepared to explicate relationships among tasks, content strands, and content instruction sessions for units or parts of units. These diagrams are included in corresponding task system summaries. A task system summary from Phase I is included in Appendix D, by way of illustration.

Phase II Products and Timelines

Table 1 presents timelines for data collection and product development for Phase II of the Managing Academic Tasks study. Two major deliverables that will be produced in Phase II are included in the table. The first is the final technical report of the high school study, scheduled for October, 1985. This report will describe and discuss findings from the high school case studies in English and

biology classrooms. It will draw on classroom observations, task analyses, and interviews of teachers and students to describe the enactment of academic tasks in high schools, examine students' opportunities for higher order learning, and summarize what has been learned about the formulation, conduct, and evaluation of tasks in secondary schools. This deliverable may be a two-part document, reflecting the different nature of task systems in English and science classes.

A second major deliverable will draw on both Phase II and Phase I of the Managing Academic Task study. This is a report, scheduled for September, 1985, specifically for the teacher education community (preservice and inservice) on practical applications of the MAT findings. It will include suggestions for observing academic tasks in classroom settings as well as recommendations for helping teacher education students or practicing teachers understand how to plan and manage academic work effectively. Special attention will be given to contributions of the research to the knowledge base for teacher education, and an effort will be made to integrate these findings with previous research findings regarding classroom management.

References

Adler, M. (1982). The Paideia Proposal: An educational manifesto. New York: Macmillan

Boyer, E. L. (1983). High school: A report on secondary education in America. New York: Harper and Row.

Carter, K., & Doyle, W. (1982, March). Variations in academic tasks in high- and average-ability classes. Paper presented at the annual meeting of the American Educational Research Association, New York.

The College Board. (1983). Academic preparation for college: What students need to know and be able to do. New York: The College Board.

Coulter, D., Williams, H., & Schulz, H. (1981). Formal operational ability and the teaching of science processes. School Science and Mathematics, 81, 131-138.

Davis, R. B. (1983). Diagnosis and evaluation in mathematics instruction: Making contact with students' mental representations. In D. C. Smith (Ed.), Essential knowledge for beginning educators (pp. 101-111). Washington, DC: American Association of Colleges for Teacher Education.

Dawes, R. M. (1975). The mind, the model, and the task. In F. Restle, R. M. Shifrin, N. J. Castellan, H. R. Lindman, & D. B. Pisoni (Eds.), Cognitive theory (Vol. 1). Hillsdale, NJ: Lawrence Erlbaum Associates.

Doyle, W. (in press). Effective classroom practices (secondary). In R. M. J. Kyle (Ed.), Effective schools sourcebook. Washington, DC: National Institute of Education.

Doyle, W. (1983). Academic work. Review of Educational Research, 53(2), 159-199.

Doyle, W., & Carter, K. (1984). Academic tasks in classrooms. Curriculum Inquiry, 14(2), 129-149.

Doyle, W., Sanford, J. P., Clements, B. S., French, B. S., & Emmer, E. T. (1983). Managing academic tasks: Interim report of the junior high school study (R&D Rep. 6186). Austin: Research and Development Center for Teacher Education, The University of Texas at Austin.

Eaton, J. F., Anderson, C. W., & Smith, E. L. (1984). Students' misconceptions interfere with science learning: Case studies of fifth-grade students. Elementary School Journal, 84, 365-379.

Erickson, F. (1982). Taught cognitive learning in its immediate environment: A neglected topic in the anthropology of education. Anthropology and Education Quarterly, 13, 149-180.

Erlwanger, S. H. (1975). Case studies of children's conceptions of mathematics--Part 1. Journal of Children's Mathematical Behavior, 1, 157-283.

Fisher, C., Berliner, D., Filby, N., Marliave, R., Cahen, L., & Dishaw, M. (1980). Teaching behaviors, academic learning time, and student achievement: An overview. In C. Denham & A. Lieberman (Eds.), Time to learn. Washington, DC: National Institute of Education.

Good, T. L. (1983). Classroom research: A decade of progress. Educational Psychologist, 18(3), 127-144.

Goodlad, J. I. (1984). A place called school. New York: McGraw-Hill.

Greeno, J. G. (1983, April). Skills for representing problems. Paper presented at the annual meeting of the American Educational Research Association, Montreal, Canada.

Hackling, M., & Treagust, D. (1984). Research data necessary for meaningful review of grade 10 high school genetics curricula. Journal of Research in Science Teaching, 21(2), 197-209.

Helm, H., & Novak, J. (Eds.). (1983). Proceedings of the international seminar on misconceptions in science and mathematics. Ithaca, NY: Cornell University.

Laboratory of Comparative Human Cognition. (1978). Cognition as a residual category in anthropology. In B. J. Siegel, A. R. Beals, & S. A. Tyler (Eds.), Annual review of anthropology (Vol. 7). Palo Alto, CA: Annual Reviews, Inc.

Mitman, A. L., Mergendoller, J. R., Packer, M. J., & Marchman, V. A. (1984). Scientific literacy in seventh-grade life science: A study of instructional process, task completion, student perceptions and learning outcomes. San Francisco, CA: Far West Laboratory for Educational Research and Development.

Novak, J. D. (1984, April). Learning science and the science of learning. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Nussbaum, J., & Novick, S. (1982, April). A study of conceptual change in the classroom. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Lake Geneva, WI.

Posner, G. J., & Strike, K. A. (1983, April). A theory of conceptual change: Explanation and application. Paper presented at the annual meeting of the American Educational Research Association, Montreal, Canada.

Sanford, J. P. (1984). Presenting, explaining, assisting: Content instruction in junior high classrooms (R&D Rep. 6188). Austin: Research and Development Center for Teacher Education, The University of Texas at Austin.

Sirotnik, K. A. (1982). The contextual correlates of the relative expenditures of classroom time on instruction and behavior: An exploratory study of secondary schools and classes. American Education Research Journal, 19(2), 275-292.

Stake, R. J., & Easley, J. A. (Eds.). (1978). Case studies in science education (Chapters 14 & 16, Booklets XII & XIII). Urbana: Center for Instructional Research and Curriculum Evaluation, University of Illinois.

Stewart, J. (1982). Difficulties experienced by high school students when learning basic Mendelian genetics. The American Biology Teacher, 44, 80-84.

Stewart, J. (1983). Student problem solving in high school genetics. Science Education, 67(4), 523-540.

Stewart, J., & Dale, M. (1981). Solutions to genetics problems: Are they the same as correct answers? The Australian Science Teacher's Journal, 27(3), 59-64.

Tasker, R. (1981). Children's views and classroom experiences. The Australian Science Teacher's Journal, 27(3), 33-37.

Ward, B. A., & Tikunoff, W. J. (1982, March). Lessons from the Junior High School Transition Study: how can we restructure schools to make them more successful for all students? Paper presented at the annual meeting of the American Educational Research Association, New York.

Table 1

Timeline for Phase II, MAT

Project Activity or Product	Begin Work	Completion Date
Obtain teacher nominations for sample	2/1/84	3/31/84
Contact, interview, and select teachers	4/1/84	5/15/84
Data collection, Teacher 9, biology		
Period 1	8/27/84	8/31/84
Period 2	11/1/84	12/15/84
Data collection, Teacher 10, biology		
Period 1	8/27/84	8/31/84
Period 2	11/12/84	1/10/85
Data collection, Teacher 11, English		
Period 1	8/27/84	9/28/84
Period 2	11/31/84	12/6/84
Task and Task System Analysis*	8/84	5/85
High School MAT Report (deliverable)	3/1/85	10/31/85
Report of Practical Applications of MAT (deliverable)	5/1/85	9/30/85

* Ongoing during and after data collection.

Appendix A

Excerpts from Topic List, Class 7-8, from Phase I, MAT

Excerpts from TOPIC LIST

MAT Teachers 7 & 8
(Combined English/Social Studies Class)

8/29/83 (Monday)

1. Teachers introduced themselves to the class, took roll, and then presented class and school rules and procedures for behavior and academic work. Students copied down the class rules and orally volunteered rationale for the rules given.

8/30/83 (Tuesday)

1. Seating was rearranged (alphabetic seating).

(1) *2. Teacher 8 introduced Root Study homework assignment 1 and called on volunteers for some definitions. Students copied roots and words from a transparency on the overhead projector. (Task 1)

3. Teacher 7 reviewed class and school rules by asking questions and by calling on volunteers for answers.

(2) *4. Teacher 7 and then Teacher 8 introduced and explained Government Watch homework assignment 1 by asking questions about government and by calling on volunteers for answers. (Task 2)

5. Teacher 8 did a "get acquainted" activity where students wrote something about themselves and then orally introduced each other from these writings.

8/31/83 (Wednesday)

(1) *1. Teacher 8 went over the Root Study homework assignment 1, asking for definitions and examples of words which contained the various roots. The teacher called on volunteers for answers. (Task 1)

2. A social studies writing pretest was given in which students wrote five complete sentences about pictures of Indian culture posted at the front of the room. The teacher collected these papers.

3. A spelling pretest was given in which Teacher 8 played a tape recording of words students were to write down. Students exchanged and corrected these papers from a transparency on the overhead projector; and papers were collected by the teacher, although students were not to receive a grade for these pretests.

4. Teacher 8 had students underline key words and phrases in an article and then had students write two-to-three sentence summaries of the article. The teacher then read paragraphs in the article and called on volunteers to identify orally the key words and phrases and to read their summaries to the class. (Not collected)

5. Teacher 8 had students take notes on how to write their Government Watch summaries form a transparency on the overhead projector.

(3) *6. Teacher 8 passed out an article in which students were to underline key words and phrases and to summarize for homework. (Task 3)

7. Teacher 8 had students read and orally summarize segments of a booklet containing school district rules, policies, programs, etc.

9/1/83 (Thursday)

1. A social studies pretest was given in which Teacher 7 dictated 50 words for students to write. Students exchanged and corrected papers from a transparency on the overhead projector, and the teacher collected these papers.

2. Students read and discussed segments of a booklet containing school district rules, policies, programs, etc.

(3) *3. Teacher 8 orally questioned students about key points and summaries of an article done for homework. (Task 3)

(3) *4. Teacher 8 had students rewrite summaries of the article done for homework in class. She then called on volunteers to read their summaries aloud. (Task 3.)

(4) *5. Teacher 7 gave Government Watch homework assignment 2. Students were to find international articles of governmental importance, underline the main ideas, and write two-to-three sentence summaries for each article. (Task 4)

6. A capitalization, punctuation, and usage pretest was given, taken from the written test booklet. Students filled in a computer answer sheet, and tests were collected by the teacher.

7. Students covered books and filled out book cards.

9/2/83 (Friday)

1. A writing pretest was given in which students were to answer one of two given questions by writing a paragraph about it. The teacher collected these papers.

2. A geography pretest was given in which students filled in a computer answer sheet. The teacher collected these papers.

3. Students filled out information cards with address, etc.

4. Students were divided into groups and given an hypothetical problem situation of being stranded on an island and were to decide in a group what to do in this situation. Students then orally reported their decisions to the class. Teacher 7 then discussed the rationale for the exercise and related it to the Government Watch.

9/5/83 (Monday)

No class

9/6/83 (Tuesday)

(5) *1. Teacher 8 introduced Root Study homework assignment 2. Students copied roots and words from a transparency on the overhead projector. (Task 5)

2. Teacher 8 discussed procedures for taking class minutes and has students take notes as Teacher 7 wrote them on the board.

3. Teacher 8 discussed the procedure for keeping class notebooks.

4. Teacher 8 discussed time management and introduced a filmstrip on this topic. Students watched the filmstrip and took notes as and when specified by the teacher. The teacher stopped the filmstrip periodically and discussed the content by asking questions and calling on volunteers for answers.

5. Teacher 8 gave a reading assignment from the grammar book for homework.

(5) *6. Teacher 8 gave an addition to Task 4--two more international government articles for the Government Watch Assignment 2. (Task 6)

(6) *7. Teacher 7 gave the Government Watch homework assignment 3. The same procedure was to be used as the one given for previous Government Watch assignments. (Task 6)

(7) *8. Teacher 7 introduced journal writing. Students wrote about a topic given on a transparency on the overhead projector.

9. Teacher 7 discussed students' decision-making processes in a group activity done on 9/2 by asking questions and calling on volunteers for answers. Students were again divided into groups and given the following problem situation to solve, "Who shall be allowed sanctuary in a fallout shelter during a nuclear disaster?" The teacher then called on students for reports of decisions make by their groups and the rationale for decisions made.

11/3/83 (Thursday)

1. Teacher 8 discussed sentence structure in the story on Rip Van Winkle by having students read and identify sentences parts orally. She then elaborated on the correct responses.

(30,36) *2. Teacher 7 continued discussing a descriptive paragraph about the murder of Susie Schmoo. She then returned students' descriptive paragraphs on the Yago environment and discussed problems with these paragraphs. (Tasks 30 and 36)

(30,31) *3. Students began working independently on writing paragraphs for the Indian Unit. Teachers 7 and 8 circulated around the room providing individual assistance when requested. Tasks 30 and 31)

(25-31) *4. Students were given in-class research time to work on the Indian Unit assignments. Teacher 7 then reviewed all component assignments of the Indian Unit. (Tasks 25-31)

11/4/83 (Friday)

(55) *1. Teacher 8 dictated Root Study test 7 (Task 55). Students exchanged and corrected papers as she called out the answers.

(51) *2. Teacher 8 told students they would have an English 6-weeks test on 11/14. (Task 51)

(25-31) *3. Teacher 7 discussed the requirements and grading for the Indian Unit assignments. (Tasks 25-31)

(49) *4. Teacher 7 reminded students that Goverment Watch was due on Tuesday, 11/8. (Task 49)

(11-17) *5. Teacher 7 reviewed the requirements for Project Texas assignments and then gave students in-class time to work independently or in groups on these assignments. She circulated around the room offering individual and group assistance. (Tasks 11-17)

11/7/83 (Monday)

(25-31) *1. Teacher 7 had students organize and hand in assignments for the Indian Unit. (Tasks 25-31)

(56) *2. Teacher 7 had students fill out evaluation forms on the Indian Unit. She collected these papers. (Task 56)

3. Teacher 7 handed out parent permission forms and discussed procedure for the upcoming field trip.

(11-17) *4. Students were given in-class time to work on Project Texas assignments. (Tasks 11-17)

(40,54) *5. Teacher 7 had students average their grades, and she called out grades for notebooks (parent signatures on grading sheets) (Task 40), Rip Van Winkle notes (Task 54), and participation grades.

(57) *6. Teacher 8 had students copy Root Study homework assignment 8 from a transparency on the overhead projector and asked for definitions of some, calling on students for answers. (Task 57)

(57,58) *7. Teacher 8 discussed appositive nouns, reading from the grammar book and having students [illegible] into their notes. She [illegible] identify and punctuate [illegible] given on a transparency on the [illegible] handout. She then gave [illegible] identify appositive nouns on page 87 in the [illegible] (Task 58). She gave students in-class time to begin this homework and to work on the Root Study assignment. (Task 57)

Appendix B

Excerpts from Task List, Class 7-8

from Phase I, MAT

Excerpts from TASK LIST

Teachers 7 & 8 (MAT)

1. Root Study homework Assignment #1

   Handed in: No information

   Sessions 2: 8/30, 8/31

   Time: 23 minutes

2. Government Watch Homework Assignment #1

   Handed in: No information

   Sessions 2: 8/30, 8/31

   Time: 40 minutes

3. Government Watch Homework Assignment Practice--I.D. and Summariztion of Key Ideas of Lech Walesa News Article

   Handed in: Not handed in

   Sessions 2: 8/31, 9/1

   Time: 60 minutes

4. G ent Watch Homework Assignment #2

   Handed in: No information

   Sessions 1: 9/1 (Handed in on this date only), 9/2

   Time: 1 minute

5. Root Study Homework Assignment #2

   Handed in: No information

   Seasions 2: 9/6, 9/8

   Time: 17 minutes

6. Government Watch Homework Assignment #2 (addition to Task 4)

   Handed in: No information

   Sessions 1: 9/6

   Time: Less than 1 minute

. . . . . .

21. Indian Project -- Skeleton Time Plan

Handed in: Shown to teacher on 10/11 and 10/17. Not handed in.

Sessions 2: 10/10, 10/27

Time: (Total time for Tasks 21, 25-31, 56: 13 hours, 11 minutes)

22. Grammar Homework Assignment -- I.D. of Subjects and Verbs and End Punctuation

Handed in: 10/11

Sessions 2: 10/10, 10/11

Time: 60 minutes

23. Grammar Homework Assignment Practice--Run-on Sentences and End Punctuation

Handed in: 10/12

Sessions 2: 10/11, 10/12

Time: 29 minutes

24. Book Report

Handed in: 10/13

Sessions 1: 10/11

Time: 9 minutes

25. Indian Project -- Drawing

Handed in: 11/7

Sessions 14: 10/11, 10/12, 10/14, 10/17, 10/18, 10/19, 10/20, 10/24, 10/26, 10/27, 10/31, 11/3, 11/4, 11/7

Time: (Total time for Tasks 21, 25-31, 56: 13 hours, 11 minutes)

26. Indian Project -- Collage

Handed in: 11/7

Sessions 14: 10/11, 10/12, 10/14, 10/17, 10/18, 10/19, 10/20, 10/24, 10/26, 10/27, 10/31, 11/3, 11/4, 11/7

Time: (Total time for Tasks 21, 25-31, 56: 13 hours, 11 minutes)

27. Indian Project -- Model

Handed in: 11/7

Sessions 14: 10/11, 10/12, 10/14, 10/17, 10/18, 10/19, 10/20, 10/24, 10/26, 10/27, 10/31, 11/3, 11/4, 11/7

Time: (Total time for Tasks 21, 25-31, 56: 13 hours, 11 minutes)

28. Indian Project -- Map

Handed in: 11/7

Sessions 14: 10/11, 10/12, 10/14, 10/17, 10/18, 10/19, 10/20, 10/24, 10/26, 10/27, 10/31, 11/3, 11/4, 11/7

Time: (Total time for Tasks 21, 25-31, 56: 13 hours, 11 minutes)

29. Indian Project -- Creative Writing

Handed in: 11/7

Sessions 15: 10/11, 10/12, 10/14, 10/17, 10/18, 10/19, 10/20, 10/24, 10/26, 10/27, 10/31, 11/2, 11/3, 11/4, 11/7

Time: (Total time for Tasks 21, 25-31, 56: 13 hours, 11 minutes)

30. Indian Project -- Descriptive Paragraph

Handed in: 11/7

Sessions 15: 10/11, 10/12, 10/14, 10/17, 10/18, 10/19, 10/20, 10/24, 10/26, 10/27, 10/31, 11/2, 11/3, 11/4, 11/7

Time: (Total time for Tasks 21, 25-31, 56: 13 hours, 11 minutes)

31. Indian Project -- Analytical Paragraph

Handed in: 11/7

Sessions 15: 10/11, 10/12, 10/14, 10/17, 10/18, 10/19, 10/20, 10/24, 10/26, 10/27, 10/31, 11/2, 11/3, 11/4, 11/7

Time: (Total time for Tasks 21, 25-31, 56: 13 hours, 11 minutes)

Appendix C

Illustrations of Task Analyses

from Phase I, MAT

C-1 Social Studies/English Task, Teachers 7-8

C-15 Science Task, Teacher 1

Descriptions of Tasks (MAT Ts 7 & 8), French

Government Watch Tasks (Tasks, 2, 3, 4, 6, 20, 34, 37, 43, 49)

The Assignment:

"Government Watch" was a routine assignment containing both a written and an oral component. The written component has been labeled "Government Watch homework assignments." For this component of the assignment, students were required to find newspaper articles pertaining to each of the four levels of government, i.e., local, state, national, and international. Students were to cut out and mount the articles on paper with glue or scotch tape, underline the main ideas, and then write one-to-three sentence summaries of each article.

Students' work was to be kept in "Government Watch" notebooks which were to be collected and graded weekly (on Tuesdays). However, notebooks were collected only 3 times during the second 6-weeks grading term. In addition, the number of articles to be done for each level of government per assignment appeared to increase from beginning assignments (one per level) to later ones (although this is not certain from the available information). Because later assignments were merely mentioned as reminders for homework (as this was a routine assignment), the exact number of written tasks assigned during the observation period is uncertain.

The second component of the Government Watch assignment was oral presentations. These were 7-minute newscasts which covered the content contained within various newspaper articles (which had been collected for the homework assignments) related to a specified level

of government. Newscasts were group presentations, and the members of each group were to decide among themselves how many and which news articles they would cover, how to present the information, and what part each member would play in the presentation. Each group was to give a 7-minute presentation, after which they were to be prepared to answer any questions from fellow students concerning the content presented.

Written Homework Assignments:

Tasks 2, 3, 4, 6, 37, 49

Oral Presentations

Tasks 20, 34, 43

Time:

Total time approximately 3 hours and 30 minutes

Homework assignments: total time, 1 hour and 42 minutes

8/30

(Task 2) 11 minutes procedural instruction time

29 minutes content instruction time

8/31

(Task 3) 1 minute procedural instruction time

34 minutes content instruction time

9/1

(Task 3) 25 minutes content instruction time

(Task 4) 1 minute procedural instruction time

9/6

(Task 6: an addition to Task 4)

<1 minute procedural instruction time

10/14

(Task 37)* <1 minute procedural instruction time

10/25

(Task 37)* <1 minute procedural instruction time

10/31

(Task 49)* <1 minute procedural instruction time

* It is uncertain if these were distinct tasks, or reminders for the same task.

NOTE: Because later assignments were merely mentioned as reminders for homework (as this was a routine assignment), the exact number of written tasks assigned during the observation period is uncertain, although a total of about 1 hour and 42 minutes of observed class time was devoted to these written tasks.

Oral presentations: <u>total time</u>, 1 hour and 48 minutes plus

10/10

(Task 20) 3 minutes procedural instruction time

10/12

(Task 20) 12 minutes procedural instruction and work (preparation time

(Task 34) 2 minutes procedural instruction time

(Task 20) 34 minutes work (presentation) time

10/24

(Task 43) a couple of minutes of procedural time (Exact time is not determinable from the narrative.)

10/25

(Task 43) 10 minutes procedural time

15 minutes work (preparation) time

23 minutes work (presentation) time

10/26

(Task 43) 2 minutes procedural instruction time

7 minutes work (presentation) time

Indirectly related class time: 39 minutes on 9/2

22 minutes on 9/6

11 minutes on 9/7.

Prompts and Resources

Homework assignments

1. Teachers 7 and 8 gave a content presentation on the importance and function of various levels of government and on the process of summarizing on 8/30. The teachers provided or had volunteers provide examples of appropriate and inappropriate article topics for these assignments, and samples of completed work (done by the teachers) were circulated for students to see during this time. The teachers also projected some of this information on transparencies which students were to copy down in their notes.
2. Students practiced identifying main ideas and summarizing with an article (on the space program) in class on 8/31 and were given a similar homework assignment (Task 3) on summarizing at that time. The teacher also projected steps for summarizing on a transparency; and students were then given the opportunity to redo this assignment on 9/2, although student work was never collected or graded by teachers during the observation period.

Oral presentations

1. Teachers gave an affirmative response to a public student question on 10/12 which provided a potential opening for presentations (identification of the governmental level being covered).
2. On 10/12 the teacher suggested that presentations could take the form of panels, correspondence, individual presentations, or news reports.
3. During student presentation on 10/12, the teacher had to question group members to help them reach their 7-minute time requirement.
4. Students were allowed to use their notes during the presentations.
5. The teacher specified the number of news articles to be covered for the second presentation given. (For the earlier presentation, students were to decide this for themselves, but apparently covered too few articles to reach the 7-minute time requirement.)
6. Because presentations given on 10/12 were short of the time requirement, the teacher suggested that students practice and time their presentations beforehand during the preparation time given on 10/25 for the second presentations.
7. The teacher provided students with maps which could be used in conjunction with their presentations on 10/25.
8. The teacher circulated around the room during the preparation time on 10/25, occasionally offering suggestions (specifics of these suggestions not given in the narrative).

9. Students had done previous class activities on 9/2, 9/6, and 9/11 which required them to utilize group decision-making skills.

Accountability

Homework assignments

1. All articles were to be graded when notebooks were handed in (on Tuesdays of each week). However, Government Watch notebooks were collected and graded only every other week, on 10/12, 10/25, and 11/8 during the second 6-weeks grading term.
2. A practice exercise on summarizing (Task 3) was assigned as homework on 8/31. Students were to have completed the assignment for homework on 9/1, although they were given the opportunity to redo these assignments after a discussion of the content on that day. The assignment was then collected on the following day, 9/2, although it was not collected during the observation period.
3. Grading criteria for the homework assignments were as follows:

   how well identified were main ideas and how well articles were summarized and the appropriate reflection of the four levels of government.

   These criteria were not announced until 9/6, after the first three tasks had been assigned.)
4. Three notebook grades were given during the second 6-weeks grading term. Each grade was worth a possible 40 points, thus the grades given for Government Watch homework constituted a

total of 120 of the 1240 points given for that grading term. (approximately 9.7% of the 6-weeks grade)

5. Students' grades for the three notebook collection dates were as follows:

10/12		10/25		11/8	
Students	Points	Students	Points	Students	Points
20	40	3	45	1	50
1	38	8	40	7	40
2	35	1	37	2	38
6	30	1	36	2	35
1	28	4	35	1	34
		5	30	1	33
		2	25	1	32
		1	20	3	30
		1	15	1	29
		2	10	1	28
		3	0*	1	25
				1	24
				1	20
				1	10
				5	0*

*Students receiving zero points did not turn the assignments in. (Students apparently were given 5 to 10 points of extra credit, although it is not certain if this was given for extra work (more articles) or for exceptional work.

Oral presentations

1. The teacher announced on 10/10 that all members of a group need not participate in the actual presentation (in response to a public student question).
2. No reference was made to accountability for the oral presentations and no grades were recorded in the grade book, although it is possible that these presentations contributed to the participation or Government Watch notebook grades given.
3. The evaluation of the first presentation to be done for homework was collected on 10/13. Students were to include how well the group had worked together and made decisions, the things that went wrong, and the things that went smoothly. Although no grade was given for this task (Task 34), students who did not hand it it were to serve detention time.

How It Went

"Government Watch" was a routine assignment containing both a written and an oral component. The written component has been labeled "Government Watch homework assignments." For this component of the assignment, students were required to find newspaper articles pertaining to each of the four levels of government, i.e., local, state, national, and international. Students were to cut out and mount the articles on paper with glue or scotch tape, underline the main ideas, and then write one-to-three sentence summaries of each article.

Students' work was to be kept in "Government Watch" notebooks which were to be collected and graded weekly (on Tuesdays). However,

notebooks were collected only 3 times during the second 6-weeks grading term. In addition, the number of articles to be done for each level of government per assignment appeared to increase from beginning assignments (one per level) to later ones (although this is not certain from the available information). Because later assignments were merely mentioned as reminders for homework (as this was a routine assignment), the exact number of written tasks assigned during the observation period is uncertain.

Teacher 7 introduced the written component of the assignment on 8/30. She introduced this as a routine assignment and discussed the function and importance (and thus, the rationale for studying) the various levels of government. The teacher interspersed the content presentation with questioning, relating the importance and function of government to current events. Some of this information was presented on a transparency on the overhead projector, and students were to copy this into their notes.

Teacher 8 then introduced the topic of summarizing by having volunteers orally repeat the events of the first day of school as they had related them to their parents. The content instruction was characterized by high student participation. Students were then shown samples of completed work and given procedural instruction for the first assignment. There were numerous student complaints regarding the difficulty of finding appropriate articles for the various levels of government. Teacher 8 followed this 9-minute complaint session with a discussion of the topic of summarizing, without referring again to the difficulties expressed by the students. Students were given an article to read and summarize in class. The teacher had a few

students read their summaries aloud, and she discussed any inadequacies in their work. Students were given the steps for summarizing on a transparency on the overhead projector, which they were to copy into their notes and were then assigned a similar exercise on summarizing (Task 3) for homework. This assignment was discussed in class on 9/1 as the teacher had students read their summaries aloud. Students had difficulties identifying the main idea of the article (The article was on Lech Walesa and the Polish press.); and so were given the opportunity to redo this work after the class discussion, although students' papers were never collected or graded as the teacher had indicated they would be.

The next Government Watch homework assignment was assigned on 9/1. The teachers did not announce the grading criteria and regular notebook collection dates until 9/6, after the first three tasks had been assigned. Government Watch assigments were announced again in class on 10/14, 10/24, and 10/31. Students' notebooks were collected and graded on 10/12, 10/25, and 11/8, during the second 6-weeks grading term. (There was no information concerning notebook collection during the previous grading term.) The three notebook grades recorded were worth 40 points each, constituting a total of 120 of the 1240 points given for the 6-week term (approximately 9.7% of their grades). Students' grades were progressively lower over the grading period, with the number of students with perfect or higher scores (for exceptional work or extra credit) decreasing from 20, to 11, to 8, and the number of students receiving less than half of the total points possible increasing from 0 to 6. All students handed in the assignment on the first collection date, while three students

failed to do so on the second collection date, and five students failed to do so on the third collection date. (Products were not seen by the observers.)

The second component of the Government Watch assignment was oral presentations. These were 7-minute newscasts which covered the content contained within various newspaper articles (which had been collected for the homework assignments) related to a specified level of government. Newscasts were group presentations, and the members of each group were to decide among themselves how many and which news articles they would cover, how to present the information, and what part each member would play in the presentation. Each group was to give a 7-minute presentation, after which they were to be prepared to answer any questions from fellow students concerning the content presented.

This component of "Government Watch" was apparently introduced between the third and seventh weeks of school when observers were not present. Students gave two such newscasts, the first on 10/12 (Task 20), and the second on 10/25 and 10/26 (Task 43). Reference to these tasks was first noted during the observation period on 10/10, when the teacher announced that students were to review their subject matter in preparation for presentations to be given on 10/12. In response to a student question on this date, the teacher indicated that all group members need not participate in the actual presentation, although all members were expected to contribute to the group presentation in some way. The teacher gave procedural instructions on 10/12 and suggested potential presentation formats at that time. Students were reminded to be prepared to answer questions

after their presentation, and the fact that this was to involve a group decision-making effort was emphasized. Students were also permitted to use notes during their presentations.

Students were given 9 and 12 minutes of preparation time on 10/12, which was characterized by high student participation and cooperation, although a power struggle was apparent between two members of one of the four groups. Although details of presentations given on this date were not available, they appeared to be shorter than the 7-minute time requirement, with three to five students of each of the 7-member groups taking part in the actual presentations. Each group gave only 2- to 4-minute presentations, and the teacher had to question students to help them reach the 7-minute requirement. Following the presentations, the teacher indicated that students needed to present more news and to have more background information to answer questions for future presentations. Class members were to have taken notes on the presentations given. Students were also assigned to do an evaluation of their group presentation, including how the group worked together and made decisions, what went wrong, and what went smoothly. This was to be done as homework (Task 34), and was handed in on 10/13. Although no grade was given for this assignment, students who did not hand in the evaluation were to serve detention time.

On 10/24, the teacher again indicated that students would be giving newscasts on 10/25, which were to cover eight articles at their specified level of government. Students had been allowed to decide the number of articles to cover themselves for the first presentations, which turned out to be short of the time requirement. In addition, the teacher encouraged all students to participate in the

presentations, as 2/5 of the students had not participated in the previous presentations. The teacher also suggested that students practice giving and timing their presentations during the preparation time.

On 10/25, students were given 15 minutes of preparation time. They were also provided with maps which could be used during their presentations. The teacher circulated around the room occasionally offering suggestions as students worked. Most group members worked well together, although about one member per group was a nonparticipant.

All group members participated in the second presentation on 10/25, which were more detailed and better timed than the previous ones. Again, students were to take notes over all presentations. One group gave their presentation on 10/26, as time had run out on 10/25.

Students had done two previous class activities which the teachers related to the Government Watch assignments. These were group decision-making activities done on 9/2 and 9/6. Students were divided into groups and given hypothetical problem situations. On 9/2, students were given the situation of being stranded on an island. They were to decide, as a group, what to do in such a situation. Students then orally reported their decisions to the class. Students were also given another such activity where they were to determine, as a group, who would be allowed sanctuary in a fallout shelter in the event of a nuclear disaster and were again to report their decisions to the class. The teacher attempted to get students to provide orally a rationale for these activities, although students did not associate them with the Government Watch as the teacher had

intended. The teacher told students that these exercises were done to demonstrate a function of the government, group decision making. The connection made by the teacher between these group activities and the Government Watch tasks was not particularly clear, although students were required to use group decision-making skills in their oral presentations. Students spent approximately 1 hour and 12 minutes on these activities on 9/2, 9/6, and 9/7.

No reference was made to accountability for the oral presentations and no grades were recorded in the grade book, although it is possible that these presentations contributed to the participation or Government Watch notebook grades given.

Government Watch tasks included the following components: current events, functions and importance of various levels of government, summarizing, and group collaboration for oral presentations.

Cognitive Operations

Comprehension level

Description of Task 10, Lab Assignment: Does gas have mass and weight?

A. The Assignment

This task was one of three experiments making up the lab unit on scientific methods. Students had to perform a simple lab investigation to answer a question (to which they did not know the answer ahead of time), record observations, make a conclusion, then answer a set of questions about the experiment and related concepts. The class worked simultaneously on the three experiments during seven class days, but each experiment and its related questions received a separate grade, counted twice in the grade book. Specific requirements for Task 10 were as follows:

1. Answer the question, "Does gas have mass and weight?" by generating carbon dioxide in a plastic bag using baking soda (11.5 grams) and weak acid (25 ml), then comparing the weight of the bag full of carbon dioxide with the weight of the same bag after the carbon dioxide is released.

2. Before doing the experiment write a hypothesis on the lab ditto--"A complete sentence stating what you think the answer to the titled question would be."

3. Record five observations on the lab ditto:

a. Description of what happens in the bag when acid and soda come together.

b. Change in size of bag during 3 minutes after reaction.

c. Change in temperature of bag.

d. Weight of bag before opening.

e. Weight of bag after opening.

4. Answer 11 questions on notebook paper and make a carbon copy. Do not copy questions, and answer in "shortest possible way." Four of 11 questions were two-part. The 11 questions included some good thought questions and application questions. Students had to decide whether the observations they made were quantitative or qualitative, and what were the data in the experiment. This is application of terms. In other questions students had to think about the rationale behind some of the procedures that they used, and they were asked to explain how the validity of the experiment would have been threatened by specific changes or faults in procedures. They also had to judge whether this experiment fit their definition of a controlled experiment. Many of the questions required students to explain their reasoning behind their answers.

5. Write a conclusion in whic you state whether your hypothesis was correct or incorrect and if incorrect, how it was incorrect.

6. Turn in each lab worksheet and questions as they are finished by putting them in the Period 3 folder on the teacher's desk. Staple original copy of questions to lab data sheet.

7. Record units for all measurements (a standing requirement, reminded 2-14-83).

8. Standing requirements and conventions included: Use one side of the paper only; write neatly; skip a line between major sections of the lab write-up; and label each section (e.g., hypothesis, procedures, conclusions). These requirements were given to students on a handout at the beginning of the year.

B. Time

1. 2-10-83 (Day assigned): Introduction and assignment to read lab sheets over for homework--3 min.; *content discussion--43 min.

2. 2-11-83: Review of content presentation--4 min.; *general directions for lab work--5 min.; directions for Task 10 only--9 min.; *choosing partners/getting organized--10 min.

3. 2-14-83: *Directions--5 min.; *work in lab--39 min.

4. 2-15-83: *Work in lab and on questions--45 min. (some turn in)

5. 2-16-83: *Work in lab and on questions--35 min. (some turn in)

6. 2-18-83 (Day due): *Work in lab and on questions--44 min.; *Directions--1 min.

7. 2-21-83: Some students, particulary those who had been absent, continue to work on Task 10 or 11, but most work on Task 12--possible 40 min.; plus directions--4 min.

*8. Since Tasks 10-11 and to some extent 12 and the optional A/B activities were worked on simultaneously by different students, in different order, accurate count of class time is impossible. Some students finished Task 10 and turned it in on 2-15-83. For Tasks 10-12 considered as a unit (lab assignments on scientific method) total task time was 341 minutes.

9. Task 9, done for homework, was directly related but a separate task, 2-11-83.

10. Tasks 7 and 8, discussion and homework, 2-9-83, were indirectly related (related content, but before Task 10 was defined). Also Tasks 10-12 were closely related to work done 1-16-83 to 2-9-83 (Tasks 1-6) because it entailed application of metric measurement skills developed in Tasks 1-6.

*See Item 8 this page.

C. Prompts and Resources

1. The lab sheet described materials and procedures in a step-by-step fashion, including three cautions in bold type: Quickly seal the bag; make sure the entire bag is on the balance pan; and be careful not to spill the contents.

2. Teacher went over the lab directions in class, walking through or demonstrating procedures, except avoiding showing the reaction students were to observe or the weights.

3. Also the day students began lab work, the teacher demonstrated how to hold the bag when pouring in the acid, how to observe the reaction, and to close the top quickly.

4. The teacher reminded students to zero their balances first.

5. Written instructions told students to review the handouts, Performing An Experiment and Scientific Measurement, before answering questions. Answers to some of the questions (1, 2, 11) were suggested (but not given) by these handouts.

6. The handout, Performing An Experiment, was also discussed in class Thursday, 2/10, after the lab assignment sheets were given out. Discussion included practice in application of the concepts and terms that were a focus of the lab questions (e.g., What were the data in this experiment?; quantitative versus qualitative data; definition of a controlled experiment).

7. Relevant concepts were reviewed in the discussion on Friday for 4 minutes before the detailed discussion of requirements for this lab assignment.

8. Students worked in groups of their choice (no more than 3 members) and were encouraged to help each other on both the experimental

procedures and answering the questions. They were not expected to copy anyone's work, but nothing stopped them from doing so.

9. In response to a question from James R. about how to phrase the hypothesis the teacher stated (to the whole class) several possible hypotheses.

10. Teacher emphasized importance of accuracy and gave a clue: Students will be dealing in tenths of a gram and not more. She told them to write that down, but few (none?) did.

11. Also before the students began the experiment, the teacher asked the class what unit the weight of the bag would be in. After several students called out the wrong answer (kilogram) there was a discussion of what's wrong with that answer. The answer (gram) was not clearly stated, but should have been obvious from the discussion and the teacher's comment in #10, above.

12. The teacher repeatedly cautioned students to be sure that: The balance pan is clean; the rubber band is weighed both times; the whole bag is on the pan; and the scale is zeroed before they start. Thus, the teacher anticipated procedural errors and tried to help students avoid them.

13. In answer to student requests for assistance when working on questions, the teacher several times told individuals to look at specific places on specific handouts for the answer.

D. Accountability

1. The teacher announced at the beginning that 10 points would be taken from a student's participation grade if the student lost the lab packet and instructions and had to ask for another.

2. Although Task 10, 11, and 12 were worked on simultaneously, separate grades were given and each counted twice in the grade book. Thus, Task 10 was a major task for this 6 weeks term.

3. It was announced on Monday, the first lab work day, that at least two of the three experiments (10, 11, and 12) had to be handed in by Friday the 18th. Subsequently, 12 became due after the other two, and was not counted on this 6 weeks' grade.

4. All of the lab procedures (not questions) were to have been completed by Friday, the 18th, originally, but this was extended 2 days.

5. The teacher told students that the only way their hypothesis would be counted wrong would be if it is not written at all or if it doesn't relate to the experimental question.

6. The teacher reminded students that they would lose 5 points for leaving off the conclusion.

7. As far as I know, the teacher counted only one paper late (-5). This was Eric Moden's. I don't know when it was turned in.

8. There is the following grade breakdown for this task:

90-100	1 (Lynn)
80-89	8
70-79	7
60-69	6
55	3 (Eric M., Mayling, Teresa)

The teacher counted off for

leaving off the hypothesis (-5)

hypothesis not in complete sentence (-1)

no conclusion (-5)

no units (-4)

out of range weights (-4)

wrong or incomplete answer to a question (up to -5 apiece)

The teacher wrote notes to students pointing out errors and supplying missing parts of answers. Sometimes she referred students to notes written on other student's papers also.

E. How It Went

1. Students were given the dittos describing this assignment on February 10, Thursday, and were assigned to read over the experiments for homework, but there was no accounting for this. Most of the class, 2-10, was taken up with discussion of the handout, Performing An Experiment, which was related to some of the task questions. Friday, 2-11, the teacher went over the directions for the lab work and assigned Task 9, some questions related to the labs, for homework. Students began work on labs themselves on Monday, so 2 class days were spent discussing directions or content for this and two related (simultaneous) lab assignments, then 4 days were allocated to do the lab work and answer the questions for each lab. However, the teacher extended the deadline in that students could turn in this task (Task 10) without penalty on Monday, February 18, as well. Most had it done by Friday or well before. Class didn't meet Thursday. Each day some time was spent on administrative chores and announcements about other assignments; a fair amount of visiting and off-task behavior occurred while students worked on the task. About two thirds of the class were instructed to start with Task 10, finish it and turn it in before proceding to Tasks 11 and 12. About one third were instructed to start with Task 11 first and do 10 and 12 later. At least one group of three students completed

almost all of Task 10 on Monday and turned it in on Tuesday. Others turned it in also on Tuesday. Still others didn't start Task 10 Monday at all. Several students were not allowed to work in the lab Monday until they first finished their written homework assignment (Task 9) (e.g., Mayling and Eric M. didn't start work until 10 minutes before the end of the period because they were doing their homework). Tuesday some students spent a lot of class time arranging their notebook instead of working on the assignment. On Wednesday, Eric and Mayling were not allowed to start work until they corrected Task 9 (that they did in class Monday). This took 21 minutes of class time for these two students.

2. Questions that students required help on during class were, in order of frequency: 11 (Was this a controlled experiment?); 5 (Why did the entire bag need to be on the balance pan?); and 3 (What kind of substance was produced by the reaction?). The teacher usually gave a hint or directed students where to look to get information, but she did not provide answers outright. Students worked together and shared answers, but most of the answers on students' papers appeared to have been individually generated rather than shared verbatim. Almost half the class turned in their lab sheet with measurements that were out of range of possible answers, but almost all were able to demonstrate that gas has weight and most seemed to have gotten that point. Over half the class failed to write an acceptable conclusion. Many just left it off or failed to comment on their hypothesis. At least two students (possibly working together) however, definitely missed the point of the experiment, concluding, "I learned that when baking soda and acid mix it will fizz and blow the bag up if you close it in time." This confusion

was partly a product of the design of the experiment. The teacher told the class and the observer later that she knew that the experimental question could have been investigated more simply by comparing the weight of a bag filled with ambient air to the same bag deflated, but chose the more complex soda/acid procedure to give students practice in weighing and measuring, and to add interest to the activity.

3. Several groups and individuals were closely watched and assisted by the teacher as they did the experimental procedures. A few groups had to do the procedure twice because they made a procedural error the first time. The most common error was in weighing out the soda and not accounting for weight of the dish. The teacher watched students' progress and looked on their papers to catch their errors, or students tried out their answers on her. During work, the teacher emphasized accuracy of experimental procedures. Except for immediately after 2-15, a day on which there was a lot of fooling around, putting notebooks together, and socializing, the teacher expressed satisfaction with student work and progress. Students appeared to be interested in the lab and questions and no one complained about the work.

4. The answer to the experimental question, "Does gas have mass and weight?", was <u>not</u> obvious to the students. Over half of the class predicted the wrong answer or didn't make any prediction for a hypothesis. Thus, the lab exercise was a meaningful investigation, not just a demonstration for most students.

5. One of the key questions students had to answer on this task was Question 11, "Was this a controlled experiment? Why/why not?" The teacher wanted students to say that it was a controlled experiment because they compared two parts or conditions and all variables were

held constant or controlled except for the test variables, which was air in the bag. Not one student of the 19 papers I have got the question right and had the right reason. Some students were distracted because only one bag was used rather than two bags weighed simultaneously. Other students' answers showed they had no understanding of the concept at all.

F. Cognitive Operations

1. This was a comprehension task both in intent and in execution. Students really did have to form a hypothesis, make inferences from a change in weight, evaluate their hypothesis, and answer 11 questions that combined comprehension operations with simple observation. They had to apply terms and concepts such as quantitative/qualitative data and controlled experiment. They had to make inferences from observations, explain rationale behind procedures used, and predict effects of a change in procedures on results.

2. Since students worked together and since the teacher often helped individuals and groups in a loud voice, students could pick up information to fill out the observations section of their lab sheet as well as answers to questions. At least some of the students appeared to have "faked" the weights on their observation data. However, the correct range of weights and differences in weights were not public knowledge during the investigation.

Using the Scientific Method: Experiment 1

Does a Gas Have Mass & Weight?

Hypothesis:

Materials: baking soda, weak acid, plastic bag, rubber band, balance, graduated cylinder, petri dish

Procedures: Read carefully

1. (a) Weigh out 11.5 grams of baking soda in a petri dish. (b) Put the baking soda in a plastic bag (c) Measure exactly 25 ml of the weak acid.
2. Put the acid in the plastic bag with the baking soda and QUICKLY SEAL THE BAG. Write a description of what happens during the bag when the acid & baking soda come into contact with one another.
3. Continue observing the reaction for 3 minutes & during this time: (a) note any changes in the size of the bag (b) feel the bottom of the bag underneath the contents & note any change in temperature.
4. Weigh the plastic bag & its contents. MAKE SURE THE ENTIRE BAG IS ON THE BALANCE PAN. Record measurements in the chart below.
5. Open the bag & "squeeze it" BE CAREFUL NOT TO SPILL THE CONTENTS. Seal the bag & weigh it again. Record measurements in chart below.

Observations: Please print written observations.

Procedure#2-description _____

_____

Procedure#3a _____

Procedure#3b _____

Weight(Mass)before opening _____ Weight(Mass)after opening _____

Questions: Answer these questions on your own paper in the shortest possible way. Make a carbon copy. Do not copy the questions.

1. Were the observations you made quantitative, qualitative or both?
2. What were the data in this experiment?
3. What type of substance(state of matter) was being produced when the baking soda & acid came into contact with one another?
4. (a) Did any changes occur in the size of the plastic bag as you observed it? (b) Why?
5. You were instructed to make sure that the entire bag was on the balance pan before you weighed it. Why?
6. When you weighed the plastic bag, the contents probably weighed less than what you recorded in your chart. Why?
7. (a) Did the bag weigh more or less after you opened it? (b) Why?
8. (a) Does a gas have mass & weight? (b) How do you know?
9. You were instructed to squeeze the bag before you weighed it the second time. Why?
10. Would your experiment have been correct if you had left the bag open after you added the acid. Why or why not?
11. (a) Was this a controlled experiment? (b) If yes, why. If no, how could you make it a controlled experiment?

Conclusion: Write your conclusion on your own paper after the last question.

Appendix D

Example of a Task System Summary

from Phase I, MAT

Summary of Task System, MAT Teacher 1

The task system for the class taught by Teacher 1 was characterized by relatively few tasks, including several major long-term assignments; a lot of laboratory experiences and class discussions; and an emphasis on developement of problem-solving and reasoning skills. The content of tasks in the 6 weeks observed focused on two related units, 1) the metric system and laboratory measurement and 2) scientific research methods. Students encountered the content through a series of well-articulated tasks and content presentations/discussions that provided them with an organized body of information, repetition of important concepts, application and practice, problem-solving interactions with other students and the teacher, hands-on laboratory experience, and content instruction in individual, small group and large group settings. From a classroom management perspective, the task system had several costs associated with it however. Despite the teacher's meticulous planning and persistent efforts, several problems with the instructional system appeared to detract from student learning and contribute to low student success on some tasks.

The Class and Setting

Teacher 1 taught eighth grade science in a middle class, predominately Anglo American junior high school. There were 25 students in the class, 13 male and 12 female. The class was heterogeneous with regard to prior academic achievement and consisted of 18 Anglo students, one Black, five Spanish surname, and one oriental student. The eighth grade course was a combined life/earth/physical science course. It met in a large, well-equipped classroom during the third class period. Student desks arranged in six rows occupied most of one half of the room. The

teacher's desk, a lab/demonstration table, and a table for equipment and supplies were arranged at the end of the room faced by the students desks. The other half of the room was occupied by six laboratory tables, each accommodating four or five students during laboratory activities only. Thus, during most instruction and seatwork activities, the class met in the front half of the room only. At other times, students worked in groups at laboratory stations or individually at their desks as needed.

How Work Was Organized

This teacher organized student work by providing 6-weeks outlines that described in some detail the requirements for core assignments (required of all students) and "optional" extension activities that were required for an A or a B in the course. Extension activities were completed by students after regular school hours or in the laboratory after core activities were completed. Core assignments required students to read handouts or other resources provided by the teacher, answer questions or complete other exercises, perform investigations or demonstrations in the laboratory, "write up" the labs, answer questions based on lab work and content presented, and take exams covering core assignments. Time allocations for tasks were usually generous and flexible. Major long-term class assignments were generally introduced by directly relevant content instruction and a related minor task or two. Most class assignments were discussed in class after they were completed and handed in, and these class discussions were a major vehicle for content instruction leading to subsequent tasks. Teacher 1 also provided content instruction by working very actively with students individually or in small groups during lab assignments, and she

meticulously graded, checked and commented on all student written work. Students who performed poorly on assignments often were required or allowed to do work over, finish, or correct it. Exams (two during the observation period) covered the content of core assignments, laboratory activities, and class discussions thoroughly, but students were allowed to use their notebooks and graded work during tests and to retake tests if they chose to do so. Class assignments (including optional activities) entailed many different levels of cognitive tasks.

Table 1 presents a summary of tasks accomplished in Teacher 1's class during the period of observation. Assignments were identified as major tasks on the basis of the amount of class time devoted to them and/or their relative weight in determining the 6-weeks grade. Four major tasks (and Optional A/B activities completed by fewer than 1f of the students, mostly out of class) accounted for 80% of class time. Thus, most of students' in-class time was directed toward the accomplishment of a relatively small number of major assignments. Two sets of laboratory activities accounted for a total of 54% of the class time. This time included content instruction, student hands-on activities performed in small groups, and seatwork time spent in answering questions about the laboratory activities. Test task time included several days of content instruction consisting mainly of discussion of previous graded tasks such as laboratory activities. Slightly less than half of the class completed one or two optional activities required to get an A or B on the 6-weeks grade. Most students worked individually on these projects outside of class, but six or seven students were observed working on these activities during class.

Assignments labeled as minor tasks on Table 1 consisted for the most part of short term, awareness-level tasks used in conjunction with introduction and content instruction for major tasks. One task (the scientific measurement vocabulary puzzle) was used for review/reinforcement, and another, the notebook grade, was essentially a procedural task. Minor tasks were mostly homework or individual seatwork assignments.

Conduct of Different Types of Tasks

Laboratory assignments. Four major laboratory assignments accounted for a major portion of observed class time and also served as focus points for most content instruction, minor tasks, and both tests. Table 1 includes brief descriptions and time allocations for the lab tasks, Tasks 4, 10, 11, and 12. Each lab assignment required students to use laboratory equipment to make and record measurements, then answer a series of questions about the data they collected, often relating findings to content of previous tasks or content presented in class.

Three of the tasks, 10, 11, and 12, were similar in structure and objectives and were worked on simultaneously, different students working on the assignments in varying sequences and at different paces. Each required students to state an hypothesis in response to a particular question (to which most did not already know the answer), follow teacher's directions to perform a simple lab investigation, record observations, make a conclusion relating to their hypothesis, and answer questions about the experiment and related concepts, such as identification of data, identification of observations as quantitative or qualitative, classification of the experiment as controlled or not controlled, an explanation of results or prediction of effects of

specific procedural modifications on results or on validity of the experiment. Task 4 was a four-part assignment that gave students experience in using the metric system and laboratory equipment to measure length or heighth, weight, volume, and temperature changes. The assignment also required students to record data in table and line graph form.

Resources for laboratory tasks included handouts summarizing relevant content (e.g., description of the metric system or lab equipment, definition of terms and concepts, an example of a "controlled" experiment); graded, minor tasks used to introduce the content; typewritten, detailed directions for the lab assignments; teacher explanations and demontrations of procedures before or during work periods; opportunity to work with other students and discuss answers; and opportunity to request teacher inspection of work and feedback before turning in the product. Teacher assistance to students who requested help during work usually took the form of rewording the question, pointing out key words in questions, telling students where to look, giving a clue, or questioning students or having them do demonstrations to help them figure out answers for themselves.

All four laboratory assignments required some problem solving, comprehension-level operations, in addition to procedural operations (e.g., measure and record), observation and simple inference, and recall operations. Although the content of Task 4 was largely procedural, some of the questions students had to answer required them to think about rationale behind procedures or predict effects of procedural modifications on results of the investigations.

Task 10, 11, and 12 were comprehension tasks both in intent and in execution. Students really did have to form a hypothesis, make inferences from data they collected, evaluate their hypothesis, and answer questions that required them to relate general concepts to particular problems. For example, in each of the three assignments they had to judge whether the investigation met the criteria of a controlled experiment. This concept had been discussed in class, and several models of controlled/uncontrolled experiments had been presented and analyzed in group discussion and (briefly) on a handout students were to use as a resource for this lab. However, each lab experiment presented students with a different task environment in which they had to apply the concepts. Experimental design models discussed in class were limited to obvious, two part designs, i.e., designs calling for comparisons of two plants or group of plants, or two tanks of fish, under uniform conditions except for test variables. None of the three in-class experiments were obvious parallels to the models discussed in class. For example, in Experiment 10 students compared the weight of a bag full of carbon dioxide to the weight of the same bag later, with the carbon dioxide removed. Most students were not successful in recognizing this as a two-part, experimental and control design. but the assignment presented them with the opportunity to analyze the elements in a new problem situation and apply a concept to the new situation.

There long term assignments involving different parts and a variety of operations required a great amount of teacher effort to manage. Allocating appropriate amounts of time appeared to be problematic, and the teacher shifted the due dates on each assignment at least once. Students worked on different parts in different sequences and at

different rates. This allowed full use of limited equipment and space, but caused problems in coordination, monitoring student progress, and keeping students accountable for production on a daily basis. Typically, each work day began with several minutes devoted to checking progress of different individuals or groups of students, reassigning work stations, and repeating or adding to instruction. The teacher seemed to keep close account of most student progress, particularly of those students who were absent on one or more days, who were typically slow, or who had failed to turn in complete lab assignments in the past. On one day the teacher circulated during student work and marked group progress on a record sheet.

Despite these teacher efforts, accountability for daily production was low. There were no products students were held responsible for each day. Time allowed was in fact more than that required by the tasks for many (probably most) of the students, especially if they worked on questions outside of class. The teacher explained to the observer in an interview (and to students during class) that she planned work this way to allow students opportunity to work on the extension (A or B) activities. She did not mention that it also permitted the slowest students to finish the work, with a lot of tutoring and shepherding by the teacher. Related to this circumstance, an interesting phenomenon was noted with regard to grouping. On Task 4 the teacher assigned student work groups. In many cases, she assigned slow students to work with faster ones. Although students were genial and cooperative, showing no resistance to this grouping arrangement, by the end of the extended work period (5 or 6 days), the group membership had shifted in many cases because of student absences. In the last available work

days, several groups of lower ability students were still working on the assignment, benefiting from close supervision, review of instruction, and direction of the teacher.

Another problematic aspect of managing the lab task was that some students required or wanted frequent assistance or attention of the teacher. Procedures for students' getting help when they needed it were not very efficient. Students frequently lost time, distracted others, and harassed the teacher. The case study of Sara provides many illustrations of the problems teachers might have in dealing with dependent students on this type of classroom task. On several occasions the teacher requested that a particular student tutor or explain directions to a student or group of students who had been absent or were behind. Every time this student interaction was observed, it had poor results. Student explanations were generally quick, sketchy, and inadequate; and the teacher almost always wound up providing the assistance herself later.

Despite generally positive task orientation and cooperation in this class, the generous and flexible time allocations without routine daily products made it difficult to sustain high levels of student attention to tasks each day. A fair amount of visiting and off-task behavior were observed as students worked on the labs. A few individuals seemed to waste a lot of time and accomplish little or nothing on some days. Some of these worked hard on other days to compensate and finish the work. A few individuals were observed copying other students' work. (In this class students were supposed to work together on lab procedures and discuss answers to lab questions, but they were not supposed to copy work. The teacher was explicit about this policy, and students reported

it in interviews, seeming to understand and accept it.) Student products and observation showed that limited copying did occur. Thus, accountability, monitoring student progress, sustaining student task engagement, and planning time allocations were all problematic aspects of management of the lab assignments.

Questions over content handouts. Two assignments, Tasks 1 and 9, consisted of sets of short answer questions students had to complete, using information handouts as resources, in preparation for major lab assignments. The first covered a handout of several single-spaced pages, and the second covered both a several-page handout over new content and a previous handout containing information relevant to the new lab assignment. In each case, the assignment had the effect of forcing students to read the material that they were instructed to use as resources for the lab assignment and ensuing related tasks (tests). In fact, these had apparently been referred to earlier in the school year as "note-taking quizes", and they were not graded at that time. These assignments, however, were turned in for a grade before students began the lab work.

Students worked on Task 1 in class 2 days and completed it at home. Task 9 was completed mostly outside of class. Students did most of the work on these assignments independently. After grading, these tasks were discussed in detail in class, this discussion serving as content instruction for ensuing tasks. Task 13, a word puzzle, used as a review of terms before a major test, was similar in that it required recall operations, using ditto handouts as resources, and it was completed independently by students, mostly out of class. It was not discussed in class however.

Tests. Besides the lab assignments, major tasks in this class consisted of two tests and (for some students) extension (A/B) activities. Tests focused on laboratory content and procedures and on content of tasks that led up to the labs. Content instruction for each test consisted of several days of class discussion over the lab assignments and related concepts. Students were supposed to take notes on the carbon copies of their lab papers or on the graded lab papers, if they had been returned.

An important feature of the tests was the fact that they were open-notebook tests--students were encouraged to use ditto information handouts, graded questions over those handouts, graded lab assignments if available or carbon copies (which students were always supposed to make) of lab assignments, with corrections and notes added during class discussion/review. They could not use textbooks. The first test, Task 6, over the metric system, history and development of measurement systems, and use of laboratory equipment for measuring, was almost entirely a recall level, multiple choice test. However it was long (several pages single spaced) and test items were state in relatively difficult ways. Grades were not high. Students' use of their notes seemed very limited.

The second test was over content and procedures of Tasks 10, 11, and 12, focusing on experimental research methods. It had four parts, one thoroughly questioning students about each lab assignment and one in which students were presented with a "new case" description of a simple experiment. On this section students had to identify treatment and control variables, critique aspects of the design, and evaluate conclusions. Questions were short answer (one word to several

sentences) throughout the test. Students wrote responses on their own notebook paper. They were given all the time they needed to complete the test. All papers were collected at the end of the first testing day, and redistributed the following day. One student worked during almost all of the second class period, but most students finished within 20 minutes of the second class period. Grades were relatively low, and most students performed about as well on the "new case" part as on the other three parts. The "new case" was in fact a case that closely paralleled examples of experiments critiqued in class, whereas, the experiment students did in class required students to extend or stretch the presented concepts of experimental design. Thus, the parts of the test covering the lab assignments contained challenging questions, but if students had their notes and graded assignments with them to use, they should have been able to locate answers to the questions on three parts of the test.

Management problems relevant to these two tasks focused mainly on problems with content instruction. Classroom discussion and teacher/student interaction leading up to the tests provide illustration of many problems that commonly occur during concept oriented lessons: pacing, smoothness, and problems with understanding resulting from inaccurate student responses, or discussion of reasoning behind wrong answers, digressions, difficulties in getting accurate information about all students' understanding, oversimplification of concepts and failure to address student misconceptions. Discussion of these content instruction problems are included in the test task descriptions and in student case studies.

One problem relevant to the experimental design test (but not the measurement test) was inadequate independent practice with the concepts needed to complete the "new case" part of the test. All of the work with these concepts previous to the test had been group efforts. Students worked together during lab assignments, and during content instruction in which similar models of experiments were analyzed, the teacher allowed a relatively small group of students (usually volunteers) to dominate question/answer sessions. Individual students were never required to independently practice tasks assessed on this exam.

Extension tasks. To be eligible for a B in the course students had to complete one of the following: a) a worksheet in which they located household items labeled in metric and English units and computed unit costs; b) a four page report on the metric system and United States' conversion to it; or c) a three-part lab assignment designed to illustrate the need for standard units of measurements. To acquire enough points for an A students also had to do one of the following: a) a textbook assignment giving students practice on experimental design concepts; b) a detailed poster identifying and explaining metric units of length, volume, and mass; and c) a laboratory assignment in which students had to design an experiment to answer the question, "Does density have an effect on the bouyance force exerted by a liquid?". Twelve of the 25 students in class completed one or more of the extension activities. Unfortunately, with the exception of the "A" lab (choice c), almost all work was done outside of class, so there is little information to use in analyzing and describing these tasks. Three boys attempted the "A" lab, and detailed description of how they

accomplished the task is presented in the student case study of David. This case study illustrates the great amount of teacher prompting and student negotiation that can accompany a high assembly task, that is, one that requires students to put together different pieces of information to assemble a product not previously seen. The "design an experiment" task was not as challenging as it first appeared, since students had really only to put together procedures from two of the required labs. However, they had to make the mental connection between the two experiments they had done and the new question presented them. The narrative of several classes in which Teacher 1 worked closely with the three boys on this experiment provides good examples of successive narrowing of the gap required to solve the problem.

The extension activites were a unique feature of the credit economy and task system structure in Teacher 1's class. It allowed (or required) the teacher to use a "loose" system that allowed some free time for some students. It provided able students with opportunity to do work beyond that required of all students. However, students had a choice not only of which task to undertake, but also whether to undertake any of the choices for an A or B. Because students had these options and because most work was done outside of class (although it was discussed in some detail in class) some of the students treated these extension activities as extra credit. One of the most capable and regularly high scoring students in the class usually accepted a C on her report card rather than complete an extension activity.

On the other hand, most students in class appeared to get along well with the combination of the credit economy and task system in this class. In fact, for the 6-weeks term observed there were no failing

grades, despite the relatively difficult content and some comprehension-level tasks completed.

Mapping Content Strands and Tasks

Table 2 is a summary list of content strands comprising the two curriculum units observed in Class 1. A significant fact to note is the shortness of the list. Compared with content usually "covered" in 7 weeks of a junior high science course, the teacher's decision to limit content to the strands listed represents a departure that is significant for the teaching of problem solving or science process skills.

Figures 1 and 2 are flow charts of the content and tasks in the measurement and scientific methods units respectively. These diagrams show that the content and tasks were logically related and sequenced. Some major concepts introduced in Task 1 were applied repeatedly across a well-articulated series of tasks. Discussion of tasks and concepts was an integral part of the task system, and task requirements as well as content presentations emphasized relationships among the tasks. Only one task was unrelated to the others (because of availability of a film).

The flow charts suggest (although it does not demonstrate in detail) that there were few "holes" in this task system. That is, there were no busy-work tasks that led nowhere, and minor or introductory tasks seemed to contribute to or culminate in major tasks that counted heavily toward a student grade in the course. One hole did exist however, not shown on the chart. Strand D was primarily skill focused. Students were to gain expertise in use of laboratory equipment. This skill-focused aspect of that strand did not show up on the culminating task, the measurement test, and only information-level questions (e.g., name

of instrument used to measure "x", meaning of relevant terms) were included on the test. This appears to be the only major discrepancy in the task system during the period observed.

The task system observed in Class 1 was not an efficient production or behavior management system. However it did appear to promote student engagement with some comprehension-level tasks, and the data collected in this class appear to be fertile ground for exploring some intriguing issues of content instruction and task management in relationship to concept oriented science teaching.

Table 1

Summary of Tasks in Teacher 1's Science Class

	Content Unit	Task	Description	Minutes	% Task Time
MAJOR TASKS	Measurement and Metrics	(4) Lab assignment on metric system & measurement	6 days of work on lab activities and questions, preceded by 2 days of content instruction and directed practice. Comprehension/recall task. Grade counted twice.	341	27%
		(6) Test over metric system & measurement	A 30-minute test preceded by 2 class days of content instruction including review of Tasks 1 and 4. Recall task. Grade counted twice.	99	8%
	Scientific Methods	(10) Lab assignment: Does gas have mass and weight? (11) Lab assignment: Does an object weigh more or less in water than in air? (12) Lab assignment: Is alcohol more or less dense than water?	Tasks 10-12 were graded separately but worked on simultaneously, forming a lab unit on using scientific methods. They consisted of lab activities and questions that students worked on in class for a total of 5 class days, preceded by 2 class days of content presentation and directions. Largely comprehension task. Each grade counted twice.	< 341	< 27%

Table 1 (cont'd)

Summary of Tasks

	Content Unit	Task	Description	Minutes	% Task Time
MAJOR TASKS (continued)	Scientific Methods (continued)	(14) Test over scientific methods and lab unit	A 1 and 1/2 day exam preceded by 4 days of content instruction that consisted mainly of discussion of graded tasks 10, 11, & 12. Largely comprehension task. Grade counted twice.	216	17%
		Optional A or B Activities	12 of 25 students turned in one or two optional activities required to get an A or B on the 6 weeks grade. Most worked individually, mostly out of class. Students had choice of three activities for a B and three additional activities for an A. Activities varied in cognitive level and difficulty. Substantial impact on grade possible.	12	<1%
		Subtotal of Time for Major Tasks		1009	80%

Table 1 (cont'd)

Summary of Tasks

	Content Unit	Task	Description	Minutes	% Task Time
MINOR TASKS	Measurement and Metrics	(1) Scientific measurement questions	Students read handout and answered recall questions. Content related to content of many tasks this 6 weeks.	78	6%
		(2) Notes on three movies on metric system	Reinforcement of classroom content instruction. Notes checked in notebook only.	49	4%
		(3) Notes on movie on atomic power	Unrelated to work this 6 weeks (film scheduling problem). Movie and class discussion. Notes put in notebook.	53	4%
		(5) Scientific measurement vocabulary puzzle	Practice with terms from Tasks 1 and 4. Recall.	15	1%
	Scientific Methods	(7) Read Performing an Experiment handout and copy onto it six steps of scientific method from textbook	Homework. Checked in notebook. Recall or less. Subsequent discussion of handout was content instruction for Tasks 9-12.	1	<1%
		(8) Rationale statements for each of six steps of scientific method	Students wrote (original) reasons why each step is necessary, followed by class discussion of reasons before task turned in. Comprehension/recall, related to Tasks 9-12.	40	3%

Table 1 (cont'd)

Summary of Tasks

	Content Unit	Task	Description	Minutes	% Task Time
MINOR TASKS (continued)	Scientific Methods (continued)	(9) Questions over scientific method and concepts of mass and weight.	Homework. Preliminary questions for lab unit on scientific methods, Tasks 10-12. Recall.	5	<1%
	All content	(13) Notebook grade	Notebook grade, which included checks on minor Tasks 2, 3, and 7, and credit for procedural effort of maintaining papers and notebook.	11	<1%
		Subtotal of Time for Major Tasks		246	20%

Table 2

Content Strands in Tasks

for MAT Teacher 1

a. Development and comparison of different measurement systems (introduced in Task 1).

b. Description of Metric System and its units (introduced in Task 1).

c. General definitions of physical properties and measurement concepts (including matter, mass, weight, volume, density, physical and chemical properties, freezing point, boiling point, melting point, solid, liquid, gas, quantitative and qualitative observations, calibration) (introduced in Task 1).

d. How to use common laboratory measuring instruments (introduced in Task 4).

e. Steps and definitions of scientific method (introduced in Tasks 7 and 8).

f. Controlling variables in an experimental design (fair test concept) (introduced in Tasks 7 and 8).

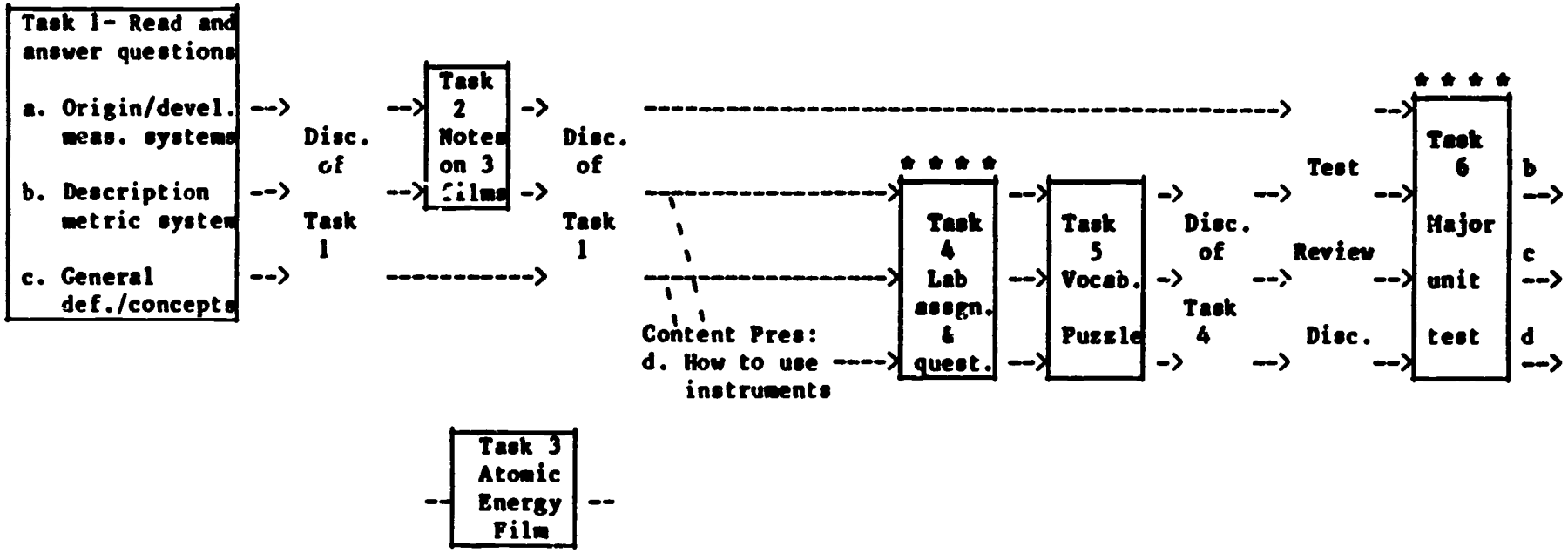
Task 11 also introduced the concept of buoyancy.

Task 12 also introduced the concept of effect of temperature on density.

Figure 1

Flow Chart of Tasks and Content in Measurement and Metrics Unit

MAT Teacher 1, 1/18 to 2/8



Content Strands a, b, c, d:
see content strands list

Optional tasks related:

B1--to Tasks 1 & 2, weakly

B2--to Tasks 1, 2, 6 directly; 5 indirectly

B3--to Tasks 1 & 2, weakly

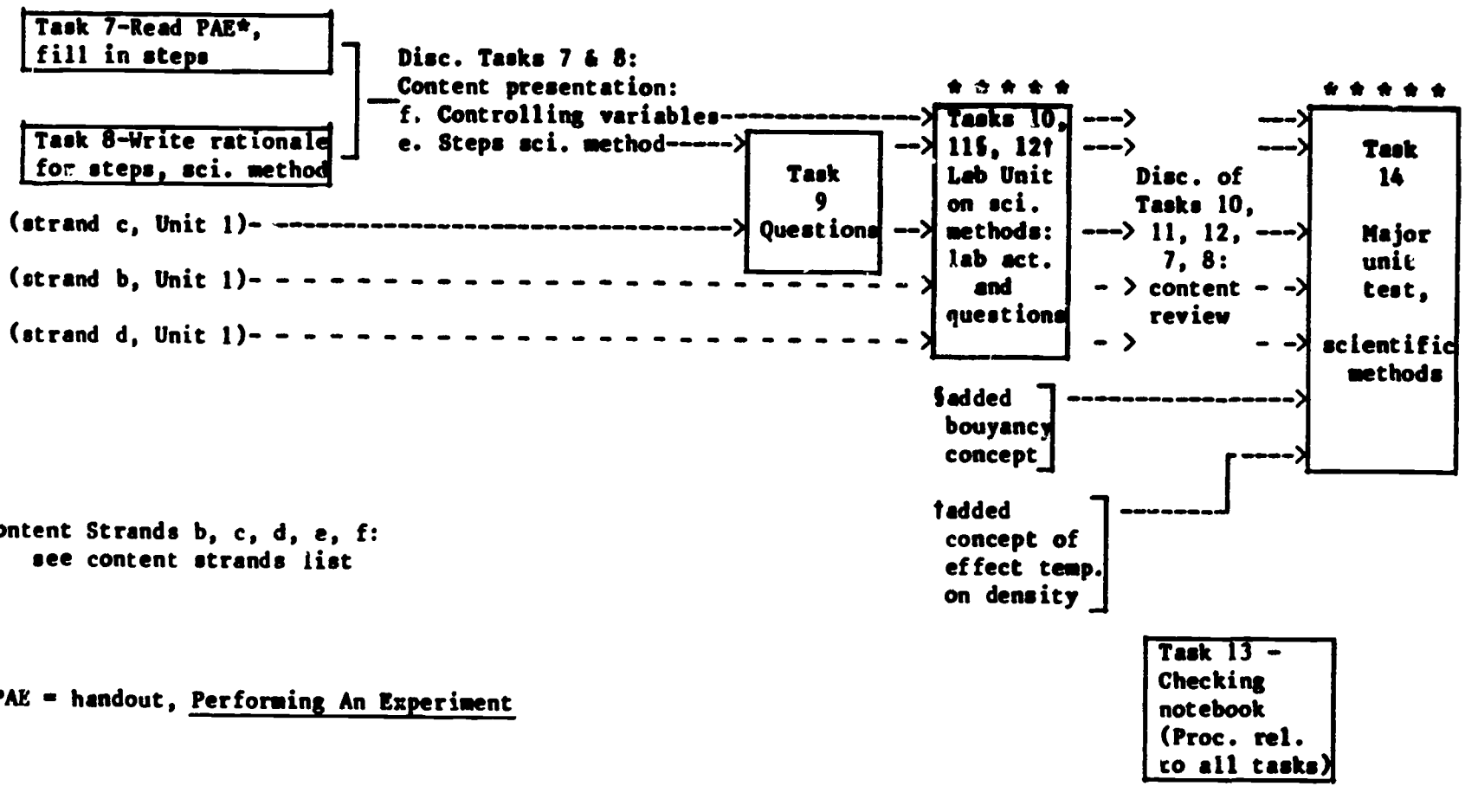
A2--to Tasks 1, 2, & 6

------- direct relationship

- - - - indirect or weaker relationship

★ ★ ★ ★ major tasks

Figure 2
Flow Chart of Tasks and Content in Scientific Methods Unit
MAT Teacher 1, 2/9 to 3/3



Content Strands b, c, d, e, f:
see content strands list

*PAE = handout, Performing An Experiment

Optional tasks related:
A1--directly to Tasks 7, 8, 14;
indirectly to 9, 10, 11, 12

A3--directly to tasks 11, 12;
indirectly to 7, 9, 1, 4

------- direct relationship
- - - - indirect or weaker relationship
★ ★ ★ ★ major tasks

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