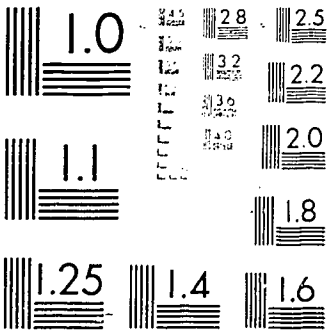

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ABSTRACT

This introductory handbook is intended to provide teachers with an overview of the Primary Education Program (PEP), designed for use with children at preschool, kindergarten and first grade levels. Background information on the development of PEP is presented and the rationale and design of the program are discussed. Briefly discussed are the three PEP curricula: the classification and communication skills curriculum, the quantification curriculum, and the exploratory learning curriculum. A list of the PEP manuals is presented in tabular form. A major part of the handbook provides information on how PEP can best be utilized in classroom settings. Specific suggestions are offered in the areas of physical design of the classroom, storage and display of materials, diagnostic testing procedures, prescriptive learning tasks, unit games, scheduling considerations, record keeping systems, teacher roles, and student roles. Research findings on the effects of PEP on classroom processes and student learning outcomes are presented. (JMB)

Introductory Handbook

Margaret C. Wang
and
Lauren B. Resnick

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PEP

Primary Education Program

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A Developmental Program for

Early Childhood Learning Skills

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Introductory Handbook

Margaret C. Wang, Ph.D. and Lauren B. Resnick, Ed.D.
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PREFACE

This introductory handbook has been prepared to provide teachers with background information about the development of the Primary Education Program (PEP) and to suggest strategies for implementing PEP in classroom settings. It includes a brief discussion of the rationale and design of the program and some research findings on its effects. A major part of the handbook provides information on how PEP can be best utilized.

PEP is an early learning program that emphasizes the development of basic academic and social skills critical to early school success. It employs a unique approach to adapting school learning experiences to individual children: the combination of a structured approach to basic skills teaching with an open learning environment conducive to fostering personal and social growth. PEP teaches children the skills and concepts that underlie successful school performance in the basic skills, as well as skills that will enable them to become increasingly independent in planning and carrying out their own learning.

To help teachers implement PEP with relative ease and maximum effectiveness, implementation procedures for (a) designing the learning environment, (b) using the PEP diagnostic tests and learning materials, and (c) managing the processes of learning and instruction were developed. These procedures, which are another unique feature of PEP, are integral to the design of the program. They are described in detail in the series of PEP manuals that accompany this introductory manual.

PEP, developed at the Learning Research and Development Center (LRDC) of the University of Pittsburgh, is a product of a systematically planned program of collaborative research and development carried out by teachers, curriculum developers, and researchers interested in improving instructional technology and classroom practice. It has been field tested and implemented by hundreds of teachers during the past 10 years. So that immediate feedback could be obtained from participating teachers, the various PEP components were initially pilot tested in two public schools in the Pittsburgh area: one in a working-class neighborhood in a suburb south of Pittsburgh; the other in an inner-city neighborhood near a public housing project. Through LRDC's participation in the national Follow Through program, PEP was also field tested in schools far removed from the center geographically. Seven school districts involved in the Follow Through program, including an Appalachian community, an Indian reservation, a rural community in the Midwest, and an inner-city district serving a black community, collaborated with us in field testing PEP.

The authors are indebted to many individuals who contributed to the design and field test of the Primary Education Program. Special credit goes to the following staff who have worked at one time or another during the past 10 years on the Primary Education Project and the Early Learning Project at LRDC.

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Special thanks also go to teachers, teachers' aides, parents' groups, and administrators from the following collaborating school districts whose insights and experiences have contributed greatly to PEP, but whose names are too numerous to mention.

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Waterloo Public Schools, Waterloo, Iowa

The authors would also like to express their appreciation to Dr. Robert Glaser, Co-Director of LRDC, for his encouragement and support through the various stages of the development and field testing of PEP; and to Dr. John Bolvin, Associate Dean of the School of Education of the University of Pittsburgh, for his assistance with the initial planning and development. Thanks go also to the LRDC Follow Through Project Directors, Dr. Warren Shepler and Ms. Betty Boston, for the critical role they played in field testing and implementing PEP in the LRDC Follow Through sites.

M. C. Wang and L. B. Resnick
Learning Research and Development Center
University of Pittsburgh
October, 1978

AN OVERVIEW OF THE PROGRAM

Theoretical Framework and Basic Assumptions

The Primary Education Program is based on a theoretical framework derived from theories and research related to child development and learning, instructional technology, and classroom practice. The program is built on some basic assumptions that are congruent with these theories and research, and is thus based on our best thinking about how children's learning and social development can best be fostered.

A basic observation from the field of child development is that certain abilities that appear early in a child's development are the foundations upon which more complex abilities are built. This observation leads to the notion, expressed in Gagne's (1967) cumulative learning theory and elsewhere, that basic skills are taught most effectively when learning experiences are organized sequentially in accordance with these stages of development. In this way, mastery of simpler skills facilitates the learning of more complex skills. To achieve this kind of sequencing, learning experiences should be grouped hierarchically in small subsets, with built-in check points.

To maximize the probability of success, mastery of each prerequisite subset of objectives should be required before proceeding to the next level. This means that children's performance should be evaluated frequently and regularly. Such evaluation not only makes steady increments in a sequential learning program possible and assures that the child has the skills needed for the next, more complex task, it also serves to reinforce the child's achievement on a regular basis. Since evaluation of the child's work is so important, we believe that diagnostic procedures and measures should be an integral part of a learning program, as they are in PEP. They are critical tools that enable teachers to diagnose student's entering behaviors, monitor their progress, and evaluate their achievement.

Research findings and our own experience with children tell us that children differ widely from one another. Rates of development vary among children, and children learn in different ways throughout the stages of their development. Further, for a given child, growth may not occur simultaneously on all fronts; a child's rate of growth in one area may be slower or faster than that in another. Children also vary a great deal in the experience and abilities that they bring to school. This is true even at the preschool level. Much has been made recently of differences associated with economic level or cultural experience. These differences are important--but anyone who works closely with children quickly learns that the differences between two individuals in the same socio-economic or cultural group are likely to be as great or greater than the differences between one group and another. For these reasons, in designing PEP we have concentrated on meeting the needs of individual children and on providing each child with the opportunity for optimal cognitive and social growth. Because children acquire knowledge and skills in many different ways, we have included in PEP a variety of materials and learning experiences, and the chance to use and manipulate materials independently. And because children come to school with different skills and experience, we believe that the proper point to start instruction is at the individual child's current level of competence.

Provision is made in PEP to do just that.

Theories of child development stress that the child's social skills and patterns of social interaction are being formed during the preschool years. Early school environments provide part of the social context in which these patterns and skills are first established. We believed that during this time children should be given a chance to engage in spontaneous interactions with other children and with adults. Opportunities should be provided for children to work and play together, to exchange information and ideas, to ask for and to give help, to resolve conflicts, to form and dissolve friendships, and in general to interact with peers and adults in adaptive and satisfying ways. Allowing children to develop in these ways means allowing them freedom of movement and interaction in the learning environment. PEP has provided for such freedom, and for enough structure to prevent chaos.

Finally, several theories suggest that children learn through action. The preschool child, as Piaget (1963) has pointed out, "... is not satisfied with speaking; he must needs 'play out' what he thinks and symbolize his ideas by means of gesture or objects, and represents things by imitation, drawing and construction" (p. 159). Thus children learn partly by their own spontaneous activities and interactions with others and the physical environment, and partly through materials and interactions that adults set up for them. Classroom environments should therefore encourage each child to experiment with materials and observe the results. Opportunities should be provided for children to manipulate things, situations, and symbols; to pose questions and seek answers; to take some responsibility for making decisions about their own learning and for carrying out learning plans; and, above all, to learn from their mistakes and successes. PEP provides children with these opportunities.

Program Goals

The primary goal of PEP is to create a school learning environment where children can become confident of their own ability to learn and to cope with their surroundings. Meeting this goal requires that children be explicitly taught the basic skills and concepts needed for school performance and that opportunities be provided for them to take increasing responsibility for managing their own learning. Thus, PEP was specifically designed to foster development in the following areas: (a) basic skills in locating, learning, and retaining new information; (b) skills in extending and transferring information to new situations and new problems; (c) motivation to engage autonomously in learning and problem solving; and (d) self-management competencies that enable the child to gain increasing control over his or her own environment.

Program Components

PEP includes two basic sets of curricula: a set of highly structured, prescriptive curricula designed to teach basic skills; and a set of exploratory learning activities designed to foster personal and social growth. The prescriptive curricula include the "Quantification Skills Curriculum," which teaches beginning mathematics operations and number concepts; and the "Classification and Communication Skills Curriculum," which is concerned with developing logical thinking and communication skills. The "Exploratory Learning Curriculum" includes a variety of independent activities in such areas as creative writing, block construction, socio-

dramatic play, music, and creative arts; and exploration in math, science, and literature. Prescriptive learning activities are generally assigned by teachers on the basis of diagnostic test results and the teacher's informal observations of the child's performance. The exploratory learning activities are generally selected by the children themselves but may be jointly planned by children and teachers.

In addition to the two sets of curricula, PEP includes a unique classroom management system, the 'Self-Schedule System" (Wang, 1974). The Self-Schedule System was designed to help teachers implement individualized instructional programs, and to help children take increasing responsibility for planning and carrying out their own learning. Studies of the system in use in classrooms have shown that it maximizes the efficient use of teachers' instructional time and children's learning time. Operating under the Self-Schedule System, children are responsible for completing all the tasks prescribed by the teacher, and generally at least two exploratory activities of their own choice, each day. Both the prescriptive and the exploratory learning activities are available to the children throughout the day. Children move from one completed task to another in any order they choose and at any time they choose. In addition to working on individual assignments, students also participate in small group instruction, individual or group tutoring sessions, and other student-(and/or teacher-) planned or spontaneous group activities.

Detailed descriptions of the various program components and how they can be used in classroom settings are provided in the accompanying series of PEP manuals. Table 1 provides a list of all the manuals that have been developed for PEP.

Table 1

A SUMMARY LIST OF THE PEP MANUALS

Curricular Component	Manual Title	A Brief Description of the Content of the Manual
Program Overview	PEP/Primary Education Program: Introductory Handbook	This handbook provides information on strategies for effective classroom implementation of PEP and a brief description of research and design work carried out during the development of PEP.
Classification and Communication Skills Curriculum	Diagnostic Tests I Diagnostic Tests II Diagnostic Tests III	These manuals contain diagnostic tests for each objective included in the curriculum. Each test includes descriptions of the objective the test is designed to assess, testing procedures, a suggested list of possible diagnoses of learning problems the student who fails to pass the test may have, and stimulus pages required for administering the test.
	Prescriptive Learning Tasks	This manual contains descriptions of the learning tasks designed to teach each objective included in the curriculum. Descriptions include a list of materials, procedures for carrying out the task, and teacher intervention strategies.
	Unit Games	This manual contains descriptions of group games designed as alternative learning activities to teach the objectives included in each unit. Descriptions include the objectives the game is designed to teach, procedures for playing the game, and teacher intervention strategies.
	Commercial Games	This manual contains the commercially produced games selected as alternative learning experiences for teaching the objectives included in the curriculum. Descriptions of the games include the objectives the game can be used to teach, procedures for using the game, and teacher intervention strategies.
Quantification Skills Curriculum	Diagnostic Tests I Diagnostic Tests II	These manuals contain diagnostic tests for each objective included in the curriculum. Each test includes descriptions of the objective the test is designed to assess, testing procedures, a suggested list of possible diagnoses of learning problems the student who fails to pass the test may have, and stimulus pages required for administering the test.
	Prescriptive Learning Tasks	This manual contains descriptions of the learning tasks designed to teach each objective included in the curriculum. Descriptions include a list of materials, procedures for carrying out the task, and teacher intervention strategies.
	Unit Games	This manual contains descriptions of group games designed as alternative learning activities to teach the objectives included in each unit. Descriptions include the objectives the game is designed to teach, procedures for playing the game, and teacher intervention strategies.
	Drill and Practice	This manual provides a series of drill and practice activities that are designed to provide additional paper and pencil learning experiences for students.
Exploratory Learning Curriculum	Learning Centers	This manual contains descriptions of six different learning centers. Descriptions include the objectives the activities included in each center are designed to teach, suggested materials to be included in each center, and teacher implementation strategies.
	Special Projects	This manual includes descriptions of six special projects designed around specific topics. Descriptions include objectives of each project, learning activities, and suggested teacher implementation strategies.
Instructional-Learning Component	The Self-Schedule System: Establishing and Managing an Adaptive Learning Environment	This manual describes the rationale and design of the Self-Schedule System and implementation strategies for classroom use.

Classification and Communication Skills Curriculum

The Classification and Communication Skills Curriculum includes basic instruction in matching, sorting, and communication. In each unit of the curriculum are activities involving labeling and oral description designed to develop the child's competency in verbal communication.

We have linked classification and communication skills in this curriculum because we believe that development of these skills go hand-in-hand. As children's language competencies develop, they learn to organize their perceptual and social world through language. As they learn to codify their world, they also learn important language skills, skills that are prerequisite to later communication abilities and to conceptual development necessary for abstract and symbolic thinking. Further, as children learn to classify and label the objects and events of their environment, they also sharpen their communication skills.

The Classification and Communication Skills Curriculum was designed in the same general format as the Quantification Skills Curriculum. It includes diagnostic tests, prescriptive learning tasks, and unit games. In order to provide additional learning experiences, however, the Classification and Communication Skills Curriculum also includes commercially produced games and developemental toys that are commonly stocked in preschool and early elementary grades in classrooms. Detailed descriptions of the Classification and Communication Skills Curriculum appear in four separate manuals as listed in Table 1.

Quantification Skills Curriculum

The Quantification Skills Curriculum is an introductory mathematics curriculum developed for children ages three through six. The curriculum is intended to teach the fundamental concepts of math and the operations (addition and subtraction) related to them. This is accomplished in forms simple enough to serve as a conceptual foundation for continuing experience in mathematics.

The curriculum consists of 14 units grouped into two Volumes. Volume I includes tasks related to simple counting and numeral recognition (from 0 to 10), comparison of sets, ordering of sets, as well as addition and subtraction skills. Volume II includes more advanced counting and numeration operations (to 1000). Learning objectives included in each unit are hierarchically organized; the learning hierarchies have been empirically investigated in a series of students (Wang, 1973; Wang, Resnick & Boozer, 1971).

The curriculum includes three basic sets of materials: (a) diagnostic tests, developed to help teachers diagnose children's learning needs and monitor their progress through the curriculum; (b) prescriptive learning tasks, designed to help individual children acquire mastery of each of the objectives included in the curriculum; and (c) unit games, which provide group learning experiences. Detailed descriptions of these curricular materials are included in the

four manuals developed for the Quantification Skills Curriculum, which are listed on Table 1.

Exploratory Learning Curriculum

The Exploratory Learning Curriculum provides a variety of learning experiences that can meet the needs and interests of individual children and develop self-motivation and skills in self-management. The Exploratory Learning Curriculum is organized around special projects in specific topics and interest centers.

The Learning Centers. Activities and materials for a total of six learning centers have been developed for the Exploratory Learning Curriculum Centers for the following areas of interest are included: creative arts; construction and block activities; listening, reading, and related language arts; science; math; and socio-dramatic play. The manual on the design and implementation of Learning Centers describes how to set up each learning area, what materials are needed, what kinds of specific skills the child can develop, what the objectives of the various activities are and what the teacher can do to help each child achieve the objectives.

Special Projects. The special projects included in the Exploratory Learning Curriculum are designed to (a) integrate the materials and resources from the learning centers in the classrooms around some central theme, (b) provide opportunities for children to carry out learning activities cooperatively with peers, and (c) provide concrete experiences in which children can apply what they have acquired in the basic skills curricula to real life situations. The projects are related to a variety of social studies and science topics, and to specific themes. Examples of themes for special projects include the work of postmen, doctors, nurses, and policemen; the food we eat; growing seeds; and cooking. Learning Activities included in these projects range from socio-dramatic play to creative writing, from charting statistics to model building.

The manual for the special projects of the Exploratory Learning Curriculum consists of (a) detailed lists of materials and props needed for the projects; (b) specification and guidelines for the teacher in preparing and introducing the projects; (c) suggested topics for discussion; (d) teacher intervention strategies; (e) suggested learning activities and objectives the activities are designed to achieve; and (f) a list of learning resources--for example, library books for teachers and students and suggested sites for field trips. Following the description of each project is a list of suggested activities cross-referenced to each of the basic skills curricula.

The topics included in the special projects manual are selected for illustrative purpose only. They do not represent an exhaustive list of topics for any given age level or for any other grouping of children. Teachers are encouraged to develop additional projects with children on topics suggested by the children, by current events, etc.

The Teacher and the Exploratory Learning Curriculum. Because of the nature of the Exploratory Learning Curriculum, the role of the teacher using the curriculum varies somewhat from traditional primary teacher roles. The role is closer to the one most preschool

teachers are familiar with. In addition to instruction and management, the teacher is called upon to serve as a "project adviser" or a "consultant" to students in their exploratory tasks. Although the children need the teacher's assistance as they prepare and set up materials and props to carry out their projects, the teacher should allow them to plan their own activities, to explore, and to make mistakes, and should intervene only when necessary. In field testing PEP, we found consistently that telling the children what to do with the specific exploratory learning materials was not particularly effective in producing the desired behaviors and outcomes of the Exploratory Learning Curriculum. Asking them what they intend to do and talking with them about the activities, roles, and props, on the other hand, tended to stimulate more activities.

The ideas and materials included in the Exploratory Learning Curriculum are not "originals." In fact, most of them now exist in classrooms in some form or another. In designing the curriculum, considerable effort was devoted to identifying existing materials that could be used to help students acquire a certain set of specific skills, and to developing means of adapting these materials for classroom use. Rather than concentrating on designing new materials, we focused on developing effective ways to display and store materials, methods and strategies for introducing the materials and activities, as well as ways of integrating these activities with basic skills learning activities. A major emphasis of our developmental work was placed on specifying teacher roles and intervention strategies that would stimulate the type of outcomes that the materials and activities were designed to produce.

It is also important to point out that it was not our intent to include an exhaustive list of materials and learning activities in the two manuals for the Exploratory Learning Curriculum. Rather, the manuals were designed as a resource for teachers, providing some examples of the type of exploratory learning activities the teacher may want to include in his or her program. Concrete "how to" suggestions for classroom implementation are also provided.

CLASSROOM IMPLEMENTATION OF PEP

As we have hinted above, the diversity of the curricular components included in PEP, and the program's primary goal of adapting learning experiences to the characteristics of individual students, forced us to focus our attention in designing the program on developing workable classroom implementation procedures. The following are some considerations that we believe are vital to successful implementation of PEP.

Physical Design of the Classroom

Systematic analysis of how classroom space can best be used is an important concern in implementing PEP. Providing adequate work space for children, as well as space for displaying and storing materials, is not only an important practical consideration in implementing PEP; it also makes a great deal of difference in motivating children to develop increasing self-direction and self-responsibility for their own learning. That is, the physical layout of the classroom contributes, along with the learning materials, to PEP's effectiveness.

Figures 1 through 6 are some examples of classroom designs. Discussion of each figure centers on the pros and cons of the design and how classroom design can help you in implementing PEP.

Figure 1. The preschool classroom shown in figure 1 is cluttered with furniture (even though chairs are not included in the drawing). The physical layout seems random. There is no clear demarcation of different activitiy areas. The result for children is likely to be not only physical crowding but cognitive confusion, as there are no clues to what activities are appropriate in what spaces.

Figure 2. Figure two shows some recommended changes in the physical layout shown in Figure 1. First, some tables have been replaced by large blocks, rugs, and open floor space. One table (large enough to seat six children) has been left for each activity area that requires table top space, and each area has been clearly defined by using shelving as partitions. In addition, clearly defined spaces have been created within each activity area for storing and displaying materials and equipment and for work space for students.

The arrangement of the activity areas was designed to encourage integration of certain areas. For example, the socio-dramatic play area was placed next to the construction and block area so that students can draw resources from both areas in their socio-dramatic play. The sand table was placed next to the block area so that students can share people, animals, and other block accessories with students working at the sand table. Multiple use of equipment is also a characteristic of the arrangement. The book shelves are used as dividers between the reading and listening area and the dramatic play area. The backs of the book shelves are used to hang dress-up clothes, and the backs of the metal supply cupboards are used as display space for creative art work.

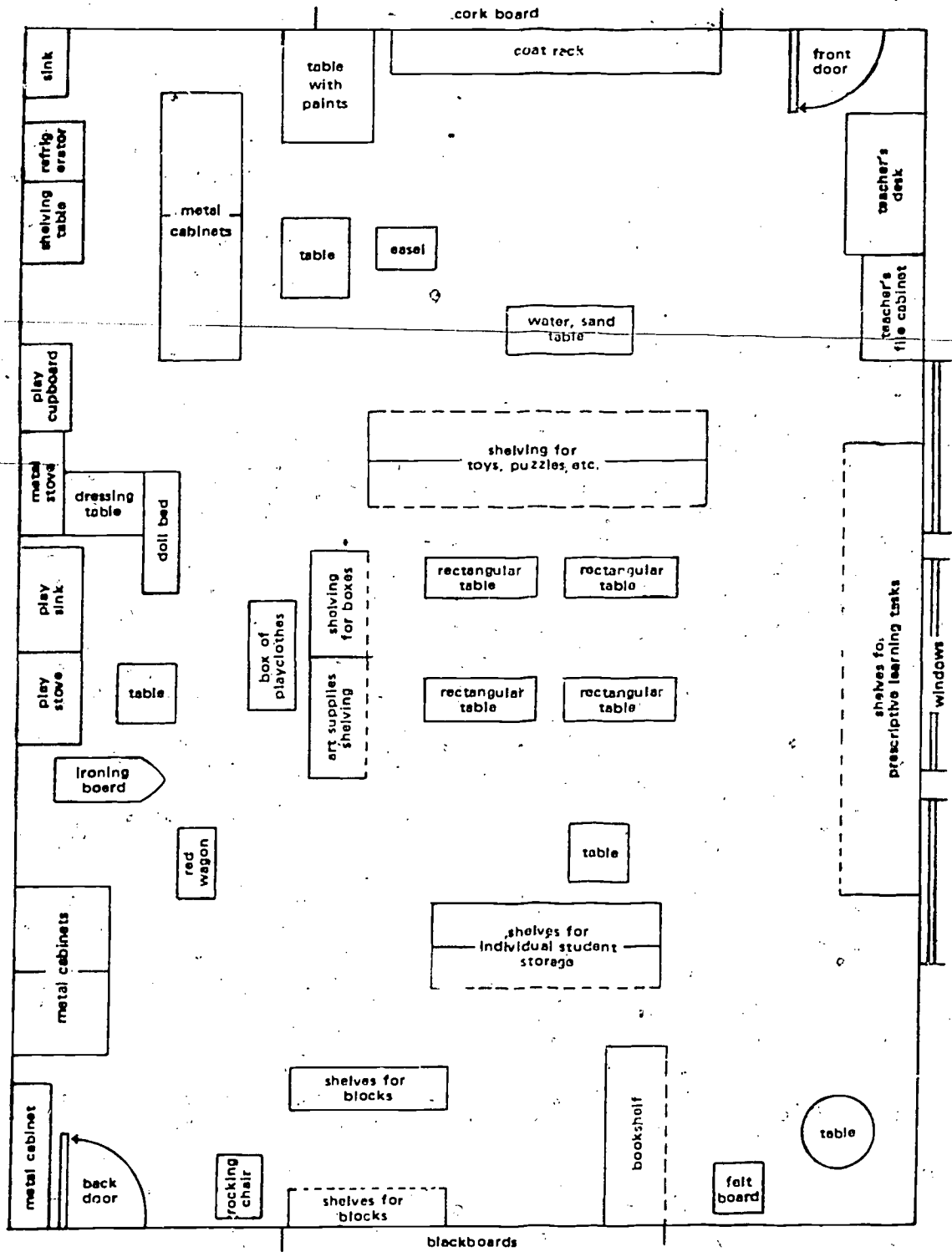


Figure 1. An example of a cluttered preschool classroom.

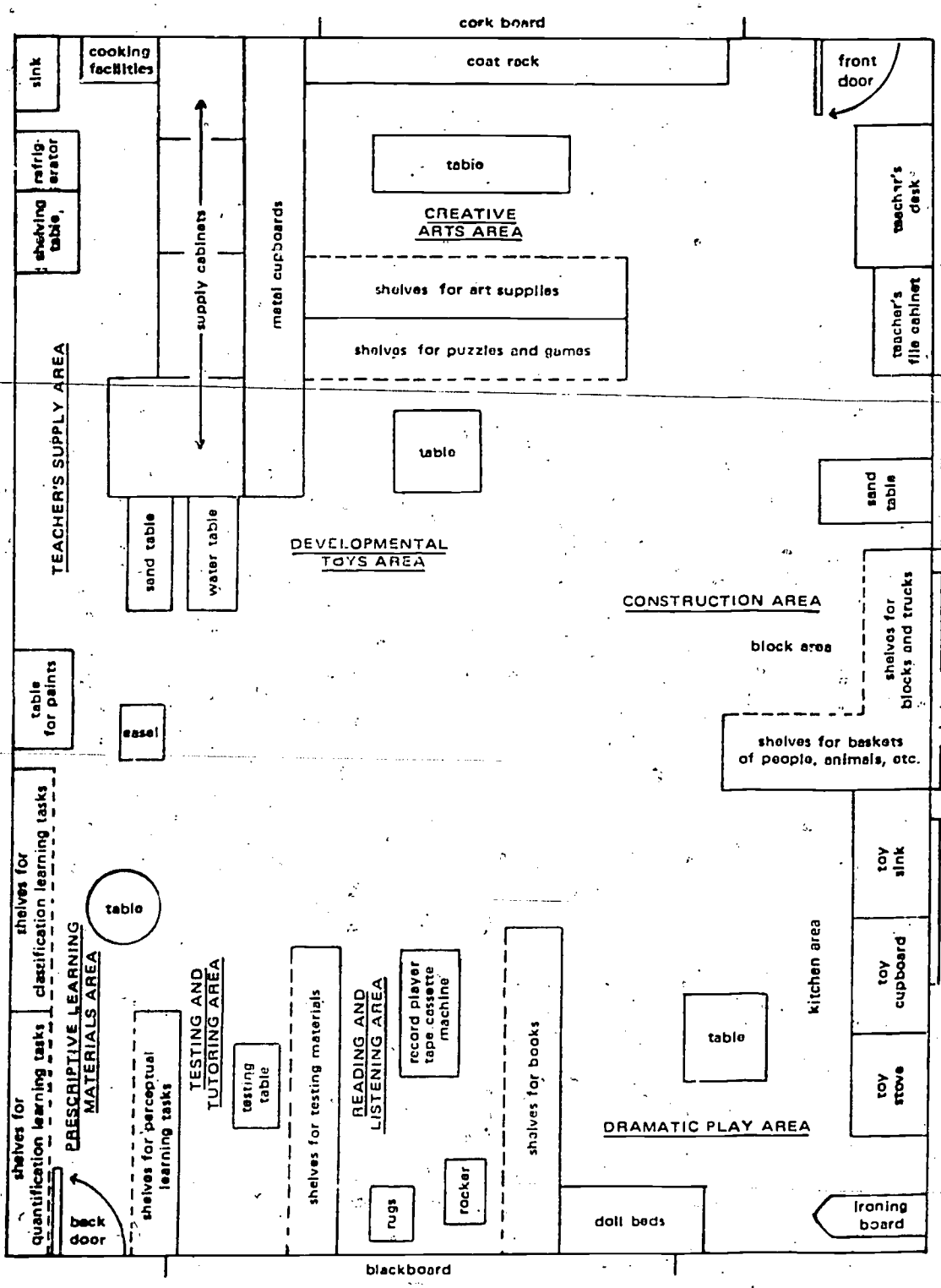


Figure 2. A redesign of the preschool classroom shown in Figure 1.

Figure 3. Figure 3 is an example of a kindergarten room designed to integrate the prescriptive learning activities with exploratory learning activities. Materials for both types of activities in a given topic are stored around the same location. For example, materials for both exploratory and prescriptive activities in math are all located in the math area. As in Figure 2, the activity areas have been carefully located to support the integration of activities, and to make maximum use of resources. The creative arts area was set up next to the sink for convenience. The back of the teacher's testing material shelves are used to dry and display paintings and drawings. Not more than one table is placed in each activity area. Note that a pile of scatter rugs was placed near the reading and listening area for children's use.

Figure 4. Figure 4 shows a fairly typical "traditional" first grade classroom. Although there are clearly defined math and reading areas, the furniture arrangement does not permit children to move freely and make use of all available space in the room. Children work at individually assigned desks that are placed close together at one side of the room.

Figure 5. Figure 5 is a recommended rearrangement of the first grade classroom shown in Figure 4 that would foster effective implementation of PEP. Individual desks have been grouped together to encourage group activities and interaction among children working in the same activity area. Extra desks have been taken out of the room to provide additional floor space so that children can move about and work on the floor. The supplies and equipment for the language arts and creative arts activities are set up together to encourage integration of these activities. The backs of the shelves for storing math and exploratory learning materials are fitted with a pegboard and the tools needed for the construction area are hung on them. The math area is set up next to the science and social studies area to encourage integration of activities in these areas.

Figure 6. Figure 6 shows another recommended rearrangement of the first grade room. Again, as in Figure 5, individual desks are grouped together to provide a large work space where students can work alone or in groups on related activities. Exploratory learning materials for science and math are located close together to encourage integration of activities in these areas. A large area in the center of the room is left open to provide work space for special group activities. This open space also permits children to create their own work space to meet the needs of a particular activity. This open space can encourage collaboration among children and greater flexibility in carrying out activities.

It is important to point out that Figures 2, 3, 5, and 6 are only four of the many possible room layouts that may be used effectively with PEP. In arranging the classroom for PEP each teacher must weigh the advantages and disadvantages of each aspect of the physical layout in terms of classroom dimensions, age group, program's needs dictated by each of the program's curricular components and above all, the teacher's own personal style. And, since furniture in most classrooms is moveable, teachers can make changes as the need arises.

Storage and Display of Materials

Many teachers who have used PEP consider a system for managing materials and equipment as one of the most important aspects of implementing in their classrooms. Such a system is important because of the wide variety of materials included in the PEP curricula.

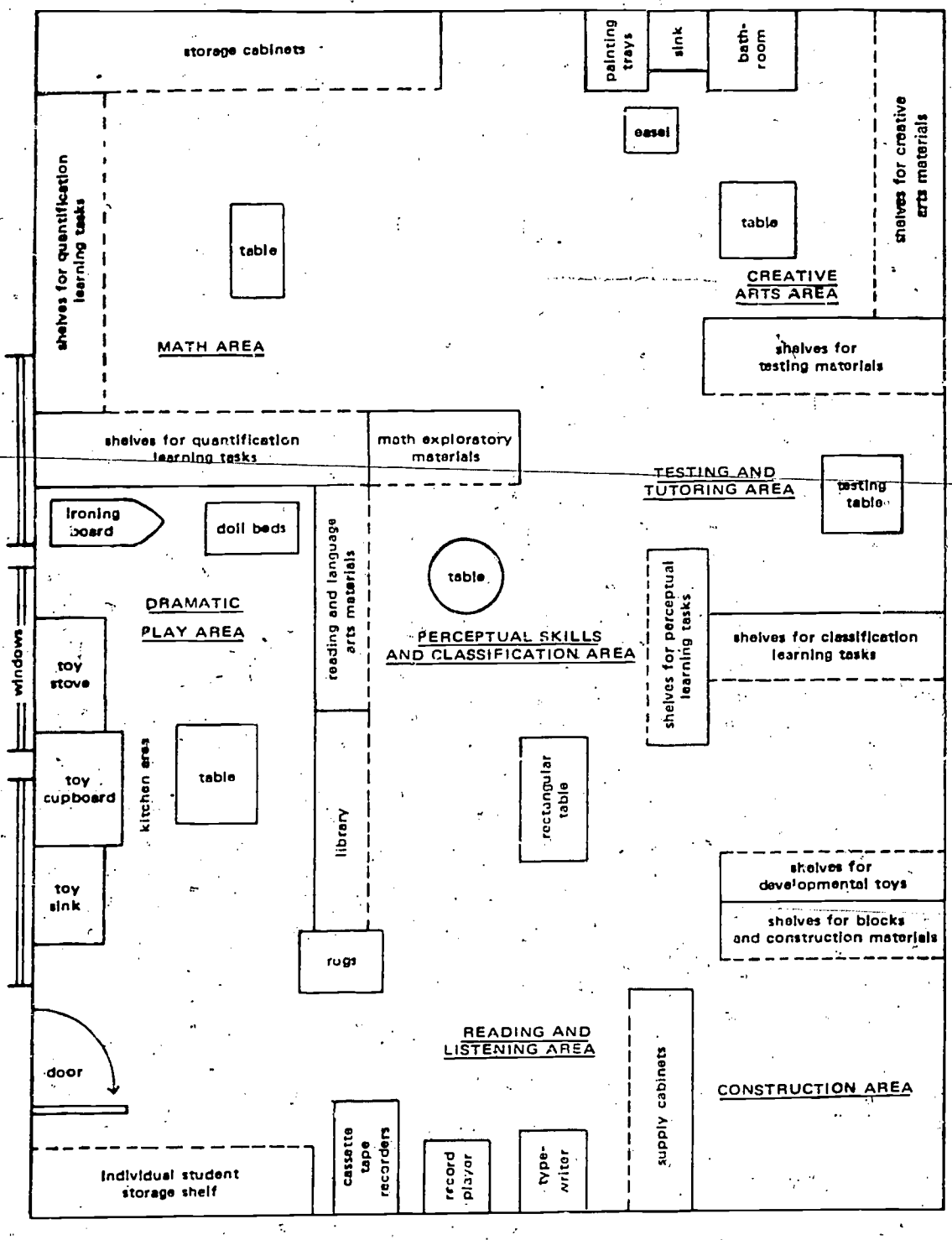


Figure 3. An example of a kindergarten classroom integrating prescriptive and exploratory activities.

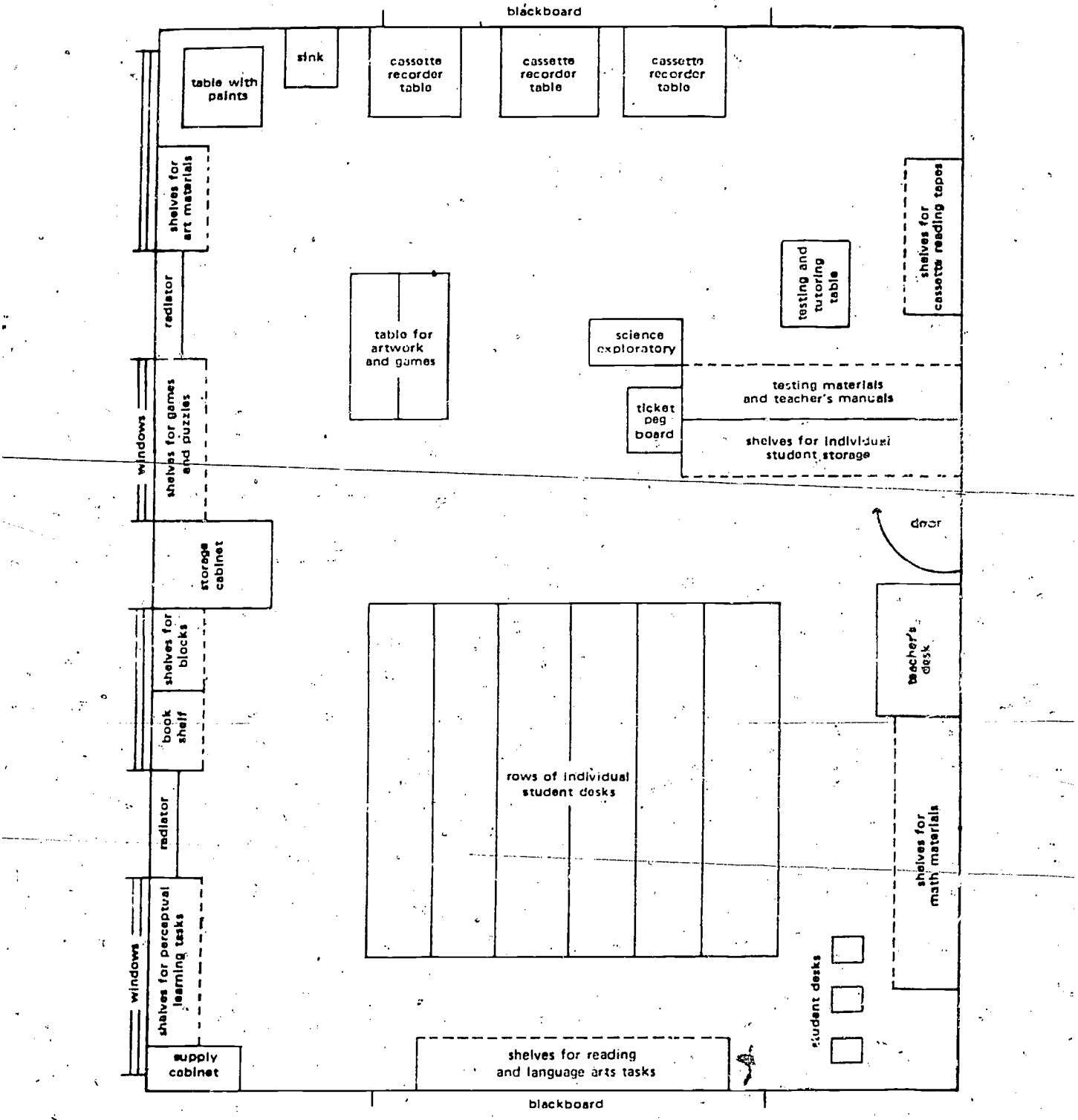


Figure 4. An example of a "traditional" first grade classroom.

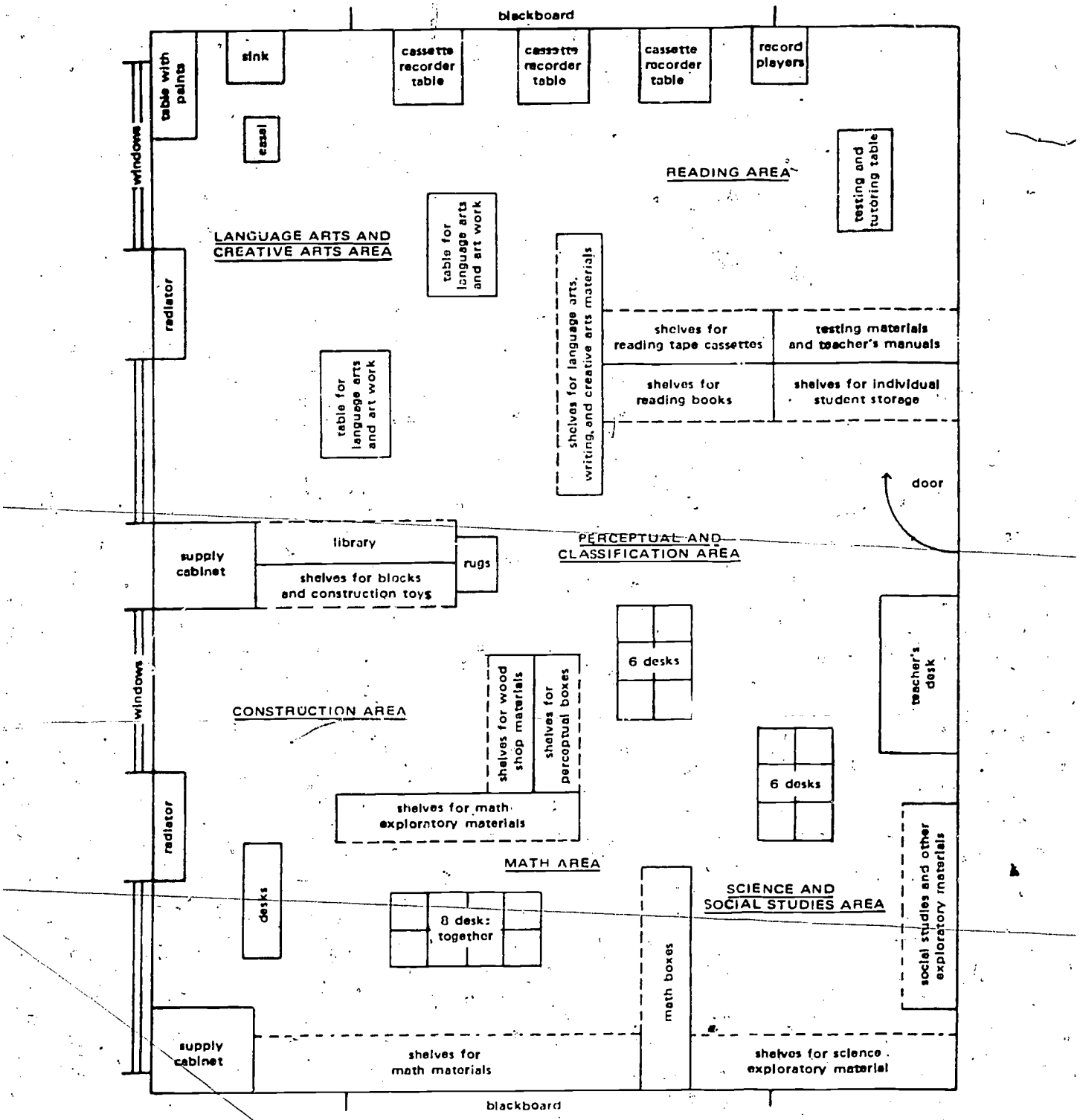


Figure 5. A redesign of the "traditional" first grade classroom shown in Figure 4.

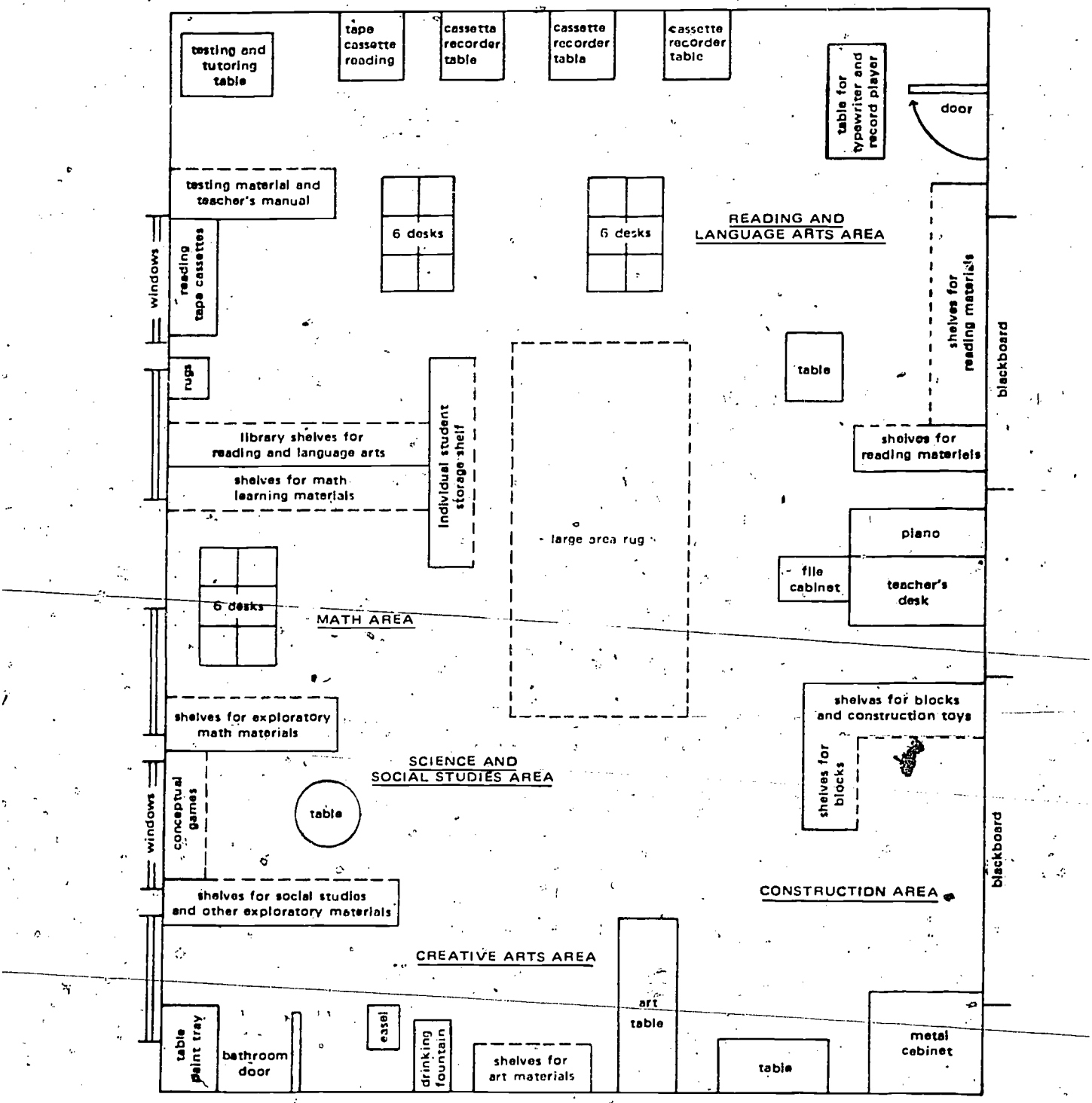


Figure 6. A recommended primary grade classroom.

A clearly defined space should generally be designated for storing materials. Materials for each of the curricula should be separated and stored with a clearly marked color- and-number coded system for easy identification by teachers and students. Manipulative materials for a given activity (or for a specific objective included in a curriculum) should be stored either in small boxes or in clear plastic bags that can be displayed on pegboards. Typically, a learning box (or bag) contains all the materials necessary for one activity keyed to a single skill (or objective). Paper and pencil tasks should include only exercises designed to match the curriculum and objective codes. This clearly established materials display and storage system, if used with a system of scheduling activities (see below) can permit children to obtain and return materials with very little teacher attention.

Diagnostic Testing Procedures

The PEP diagnostic tests have been developed to help teachers diagnose their students' learning needs and monitor their progress through the various curricula. We consider diagnosis and monitoring of each individual child's progress as the most critical element of the prescriptive learning component of PEP. Besides providing information for teachers, the diagnostic tests also provide a basis for communicating on a substantive basis with students, parents, and others concerned with the students' progress.

Diagnostic tests are given both as pretests, to assess student entry levels, and as post-tests, to determine whether a given skill has been mastered. Children entering a new unit are first pretested on objective(s) appearing at the top of the unit hierarchy, that is, the criterion objective(s) included in each unit of instruction. If the child passes the test for the criterion objectives(s), no work will be assigned for that unit, and the child will be tested for the next unit. If the child fails to pass the test, he or she will then be given the test for the next lower objective(s) in the hierarchy. This testing strategy was designed to take advantage of the hierarchical structure of the objectives for each unit of instruction. That is, we assume that children who pass a test at the top of a hierarchy are capable of passing all the lower level tests. Thus only the top objectives of the learning hierarchies need to be tested to assess a child's level of competency. Children who fail the top level tests in a given hierarchy can then be tested for the lower level objectives to determine specific instructional needs. Specific information on the testing sequence can be found on the "unit sequence information" pages included in the test manuals.

The diagnostic tests for the Quantification Skills Curriculum and for the Classification and Communication Skills Curriculum are presented in the test manuals for each curriculum. There is one test for each objective in each curriculum. The test manuals include the stimulus pages (which are used by the child during the test), detailed descriptions of the testing materials and procedures, a discussion of the behaviors being assessed, and possible diagnoses of problems children who fail to pass the test may have. The tests are organized by unit in the test manuals. Accompanying the test manuals are diagnostic testing kits, which contain the manipulative materials required to administer the tests.

Figure 7 shows a diagnostic test page. It includes a statement of the objective the test is designed to assess, the testing situation, and specific directions the teacher is to follow in administering the test. In addition, at the bottom of each test page, possible diagnoses of the

Unit 1 - COUNTING AND ONE-TO-ONE CORRESPONDENCE TO 5

Objective E - Number stated (to 5) and a set of objects (to 5); count out subset of stated size

Materials - Package "Quantification 1 E" - Moveable objects

Criterion - Must pass every item

Testing Situation	Testing Directions
1-3. Place ten moveable objects in front of the child. Put the objects back into a pile after each response. Note: When indicating the position "here" as you ask the question, allow for sufficient space to separate between the pile of chips and the "here position" where the child is to place the subset of objects counted.	Say: 1. "COUNT OUT THREE OBJECTS AND PUT THEM OVER HERE." (point) 2. "COUNT OUT FIVE OBJECTS AND PUT THEM OVER HERE." (point) 3. "COUNT OUT TWO OBJECTS AND PUT THEM OVER HERE." (point) Answers: 1. 3, 2. 5, 3. 2

Diagnosis: Child needs more work in:

1. counting moveable objects (Quantification Unit 1, objective B)
2. reciting numeral chain (Quantification Unit 1, objective A)
3. counting out subset of objects
4. remembering verbal commands

Figure 7. Diagnostic Test page

child's learning problems (should the child fail to perform satisfactorily on the tasks specified by the objective) are listed. Children who failed to pass the test shown in Figure 7 might have a variety of different learning needs. The child who failed the test because he or she cannot synchronize touches and oral counting as he or she counts objects, needs a very different kind of learning experience from a child who failed because of not being able to recite numeral chains in sequence. These diagnoses were derived from prerequisite behaviors identified by task analysis and from results of empirical validations of the learning hierarchies.

The test can be administered by the teacher or they can be done independently by children as prescriptive tasks. When children do the tests as prescriptive tasks, the teacher generally checks the accuracy of their performance as he or she travels about the classroom. Complete detailed information on how to use the diagnostic tests is included in the diagnostic test manuals.

Prescriptive Learning Tasks

The prescriptive learning tasks were developed to help children acquire mastery of the objectives included in the prescriptive curricula. Each task was designed to teach a particular skill or objective. Typically, several alternative tasks for each objective were developed to provide more flexibility in adapting learning experiences to individual children.

The prescriptive learning tasks are assigned to individual children based on diagnostic test results, as well as on informal teacher observations of their performance. Although the prescriptive learning tasks were designed for use by individual children, they can be easily adapted for use by small groups of children. Detailed descriptions of how to package, display, and use the prescriptive learning task can be found in the prescriptive learning task manuals. The learning tasks include using paper and pencil procedures, as well as manipulative materials. In general, they require minimal assistance from the teacher.

The prescriptive learning tasks are described in task manuals for each curriculum. These manuals include detailed descriptions of (a) the objective each task is designed to teach; (b) the learning task and the materials needed to perform it; (c) procedures for carrying out the tasks; and (d) suggested teacher intervention strategies, including critical questions the teacher can ask the child as he or she works on the task or when evaluating the outcomes of a particular task.

Unit Games

The unit games were designed to provide (a) additional learning experiences related to certain groups of objectives in a given curricular unit, (b) opportunities for children to apply skills learned in earlier units while acquiring new skills, (c) opportunities for children to draw from a repertoire of skills including those related to other curricular components of the program, and (d) opportunities for children to work together. The unit games are less structured than the prescriptive learning tasks. They are also more open-minded, in the sense that they require the child to apply a variety of skills taught in a given unit to new situations. Although they were designed as activities the children would select for themselves, they can be prescribed by teachers to reinforce certain skills. In general, unit games were designed to be

used by two or more children. Materials for the unit games include both those we have created and those we have adopted from commercial producers. The commercially produced materials we selected are those that can be found on classroom shelves in most preschool and kindergarten classes.

Directions for using the unit games are included in the introduction of the unit games manuals. These manuals also include description of the objectives the games are designed to teach, information on the number of players required, descriptions of the materials needed, general procedures and rules for playing the game, and teaching and tutoring suggestions. Specific suggestions for packaging and displaying materials for the unit games are also included in the unit games manuals.

Scheduling Considerations

Because PEP is individualized and because it makes use of many different activities, each of which has its own requirements for time, space, and materials, careful scheduling of the use of the classroom space, learning materials (both paperwork and manipulatives), and the teachers' and students' time is critical to the effective implementation of the program. Scheduling can lend order and structure to a classroom in which the children are working individually and in groups on many different activities at the same time. It can insure that all the resources of the classroom--teacher, learning materials, space, time--are being used most effectively and efficiently.

Teachers of PEP have employed many different scheduling strategies in implementing the program. Several of the most effective of these are discussed in the following pages.

Scheduling classroom space. In order for all the PEP materials to be used constructively, it is important to insure that children don't overcrowd some areas of the classroom and neglect others. PEP teachers have used a variety of strategies to solve this problem. One such strategy is to use a pegboard, such as the one shown in Figure 8, which lists each of the activity areas of the classroom. Under the name of each activity area are placed as many pegs as the teacher feels the area will comfortably accommodate. A name tag for each of the students is provided at the bottom of the pegboard. When a child decides to work in a given area, the child places his or her name tag on an empty peg under the name of the area where he or she has decided to work. If all of the pegs for the area have a name tag on them, the child selects another area. This system allows the children to see at a glance which areas are free, and the teacher to see where each child is working.

Scheduling activities. The question of scheduling student activities has been a major implementation problem for individualized instructional programs. Typically, the choice was between group versus individual scheduling, and free choice versus teacher-prescribed activities. All four alternatives can be included, however, within the context of a flexible school day. This is accomplished in our program through the Self-Schedule System. Under the Self-Schedule System, children can be found working in virtually every area of the classroom at any given time, with the teacher circulating among them. Small groups of children can be called together at the discretion of the teacher for tutoring, testing, or other activities.

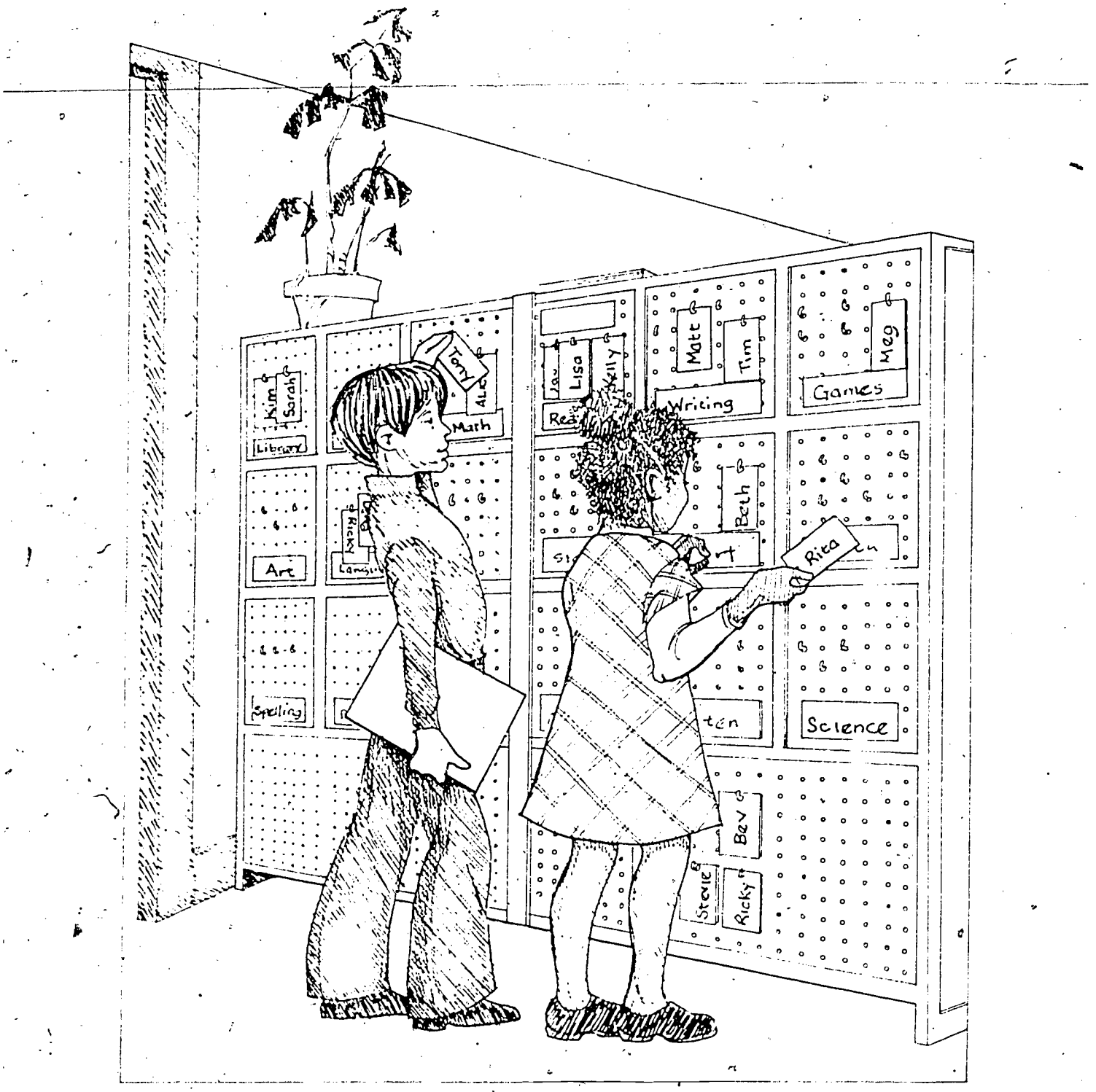


Figure 8. An example of a Peg Board used in some PEP classrooms.

Such a flexible arrangement, however, requires fairly systematic planning and management, so that teachers' and students' time is used to best advantage. Several effective ways of scheduling activities have been devised by PEP teachers. The following are a few of these which can be used in any combination that an individual teacher finds meets the needs of his or her particular classroom.

Prescription tickets were designed to inform students (and to remind the teacher of) the prescriptive learning tasks assigned to them on a particular day. In addition, the prescription ticket provides information the children need to find the materials required to carry out their assignments. Resnick, Wang, & Rosner (1977) explain how the tickets work:

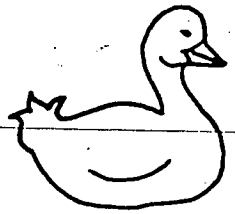
> To guide children's use of these materials, we give the "prescription tickets" at the beginning of each day. Each child's ticket is made up daily on the basis of the teacher's observations of the child's classroom performance and the results of recently administered diagnostic tests . . . .Codes on the tickets exactly match those on the boxes (or work materials). A child "follows" his (or her) ticket by finding a box whose code matches that on this ticket. Tickets may contain codes for any number of activities that the teacher deems desirable for a particular child. The codes may be specific, directing the child to a particular activity, or they may be general, permitting the child to choose one of a number of activities at a given level. Thus, the prescription system is both directive and flexible. The teacher can help select activities that match (his or) her best judgements of the child's needs and capabilities. The child can be closely or loosely directed, again depending on the teacher's judgement. The prescription tickets make it possible to provide different levels of direction to different children all within the same classroom. (p. 26).

Figure 9 shows an example of a prescription ticket for Quantification unit 7.

As shown in Figure 9, Michelle's assignment on May 14 was to work on Objective C in Quantification unit 7 (as circled on the prescription tickets). Michelle's assignments for Objective C were to work with number lines (task QVIIC) and play the Bingo game that was designed for that objective. The materials that Michelle needed to complete these tasks would be displayed on the Quantification shelf in a box, labeled with a picture of a "duck" and the letter code (QVIIC) that matches the code listed on the prescription ticket. This would allow Michelle to find the necessary materials herself. (See the section above on storing and displaying materials.) When Michelle accurately completed the task, the teacher would make a check mark next to the code to indicate that it had been completed.

The **self-schedule record form** was designed to keep the students and the teacher informed of the prescriptive assignments the teacher has made for the child, as well as the exploratory learning tasks the child has selected during each day of a particular week. It is used by the teacher and the student as a planning sheet. It also provides a record of assignments that have been accurately completed. (For more information on this topic, see the section below on record keeping systems.)

Quantification Unit 7



Name Michelle

	Date Assigned	Date Completed
Prescriptive Tasks:		
QVIIA		
QVIIB		
QVIIC	May 14	
QVIID		
QVIIE		
QVIIF		
QVIIG		
Unit Games:		
Addition Dice Game		
Bear Race		
Number Line Bingo	May 14	
Fill in the Equation		
Make Your Own Bear Race		
Additional Activities:		

Figure 9. Sample Prescription Ticket for Unit 7 of Quantification Skills Curriculum.

Figure 10 is an example of a self-schedule record form. It lists all the activity areas the teacher has set up for that particular classroom. The areas listed on the form vary from class to class, depending on what the teacher decides to include in his or her program. The form is divided into two sections, prescriptive and exploratory. The prescriptive section lists all of the prescriptive learning curricula included in the program. In the example given in figure 11, the program includes not only the PEP Classification and Communication Skills and Quantification Skills Curricula, but also a perceptual skills and a science curriculum. When the teacher prescribes an assignment for a child in a given curriculum, he or she makes a slash ☑, in the appropriate box on the form, which indicates to the child that he or she has an assignment in that particular area. When the child correctly completes the assignment, the teacher makes another slash, forming an ☒, to indicate that the assignment was completed correctly.

Listed in the exploratory section on the bottom half of the self-schedule record form are all of the exploratory activities available to students. The child may choose activities from any of the exploratory areas listed on the form. Note that the particular exploratory areas to be included on the self-schedule record form vary, depending upon the facilities of the individual classroom and the interests of the students and the teacher. In this particular classroom, children were required to complete all of the prescribed learning tasks assigned and at least two exploratory tasks each day. The children were expected to select (with teacher help when needed) the exploratory tasks they intend to work on for a given day. After choosing these tasks, the child was to make a slash in the appropriate box ☑. When the child completed a given exploratory task, the teacher made another slash in the box, forming an ☒, to indicate that the child had successfully completed the task.

The slashes on the record form shown in Figure 11 show that on Wednesday, October 18, Michelle had assignments in the Quantification Skills Curriculum and the Perceptual Skills Curriculum. As she planned her day she selected writing and make-believe as her exploratory activities. She placed her own slashes in those boxes. During the day, as Michelle completed her work, the teacher checked the work and put another slash to make an ☒ in the appropriate box on the form. Both Michelle and the teacher were able to obtain information about Michelle's accomplishments by examining the record for Monday and Tuesday of that week. The record form shows that on Monday Michelle completed all of her work except the art tasks she intended to work on that day, and that on Tuesday she completed all of her work.

Scheduling time. Using the systems described above for scheduling activities in PEP will place a good deal of the burden of scheduling class time on the students--this is what they were designed to achieve. But some portions of the school day will not be free for self-scheduling. Besides, young children need a mix of activities during their time in school. Consequently, self-scheduled time will be only part of the child's school day. The following are some typical schedules for preschool and early elementary classrooms using the Primary Education Program.

Name Michelle

Week Oct 16-20

	m	t	w	th	f
perceptual	X		/		
science		X			
quantification	X		/		
classification		X			(
1. math games					
2. library		X			
3. listening		X			
4. writing	X		/		
5. art	/				
6. blocks	X				
7. games					
8. make-believe			/		

Figure 10. Sample Self-Schedule Report Form used in a PEP classroom.

For a half-day preschool or kindergarten

8:30-8:45	Opening exercises.
8:45-9:00	Group time during which the teacher shares the day's plan with children. The children may also share ideas among themselves during this time.
9:00-10:30	Self-Schedule time during which students complete the day's assignments in prescriptive areas and in exploratory, self-selected areas. This is also used by teachers for small group instruction, to circulate among students to check work, and to give individual tutoring sessions.
10:30-10:45	Juice time.
10:45-11:15	Gross motor activities, music, and other group activities.
11:15-11:30	Small group activities, story time, or time to catch up with incomplete assignments.
11:30-11:40	Clean-up time.
11:40-12:00	Teacher and students discuss the day's accomplishments. This includes time for children to share their work with others and get ready to go home.

For a full-day kindergarten

8:30-8:45	Opening exercises.
8:45-9:00	Announcements of the day's special activities and schedule.
9:00-10:30	Self-Schedule time during which students work on their assignments in prescriptive areas or in exploratory, self-selected activities. This time is also used by teachers for small group instruction, to circulate among students to check work, and to give individual tutoring.
10:30-10:45	Milk break and recess.
10:45-11:30	Self-Schedule time, or time to attend classes in gym, music, art, or library.
11:30-11:45	Group discussion of the morning's work. The teacher may also use this time to read a story or newspaper to promote sharing of ideas and events among students. The teacher also checks the accomplishments of students to determine who needs to spend more time during the afternoon in order to get all of his or her assignments done.
11:45-12:45	Lunch

12:45-1:45	Self-Schedule time and time to attend classes in gym, music, art, etc.
1:45-2:45	Project time for students (e.g. social studies, creative writing). Teacher tutoring time with individual students. Teacher-student conferences.
2:45-3:10	Clean-up time and group meeting to discuss the day's work.
3:15	Dismissal.

Record Keeping Systems

In order to make sound instructional decisions, teachers need detailed information on their students' progress through the PEP curricula. Diagnostic testing cannot fully serve its functions without an efficient record keeping system to maintain accurate and up-to-date information about student progress. Information such as a child's short-and long-term learning history, based on accumulated student progress records, is essential for providing the best match between instructional alternatives and the individual child. The prime criterion for an effective record keeping system, however, is that it makes minimal demands on teacher time but still provides critical information about each student's learning. To meet these information needs, a variety of record keeping systems have been used by PEP teachers. We have discussed such a system--the Self-Schedule record form. Several other systems that were found to be effective are described in the following pages.

The **Student progress profile chart** was designed to provide teachers with up-to-date information about each student's progress. Figure 9 shows a student progress profile chart for the Quantification Skills Curriculum. It lists all the objectives included in each unit of the curriculum across the top of the chart. Each child's progress through the curriculum is recorded on the chart.

The teacher enters an ☒ in the appropriate space when a child has successfully passed the pretest for a given objective. If the child fails to meet the criterion on a pretest, the teacher fills in the upper left portion of the block (◩) to indicate that the child needs more work on that objective. The lower portion of the space is filled in (■) when the child passes the objective at posttesting. This indicates that the child has worked on the particular objective and has successfully mastered it. The color of the markings indicate the month which the markings were made. Therefore, by examining the progress chart, the teacher is able to get an idea of the length of time the children required to learn a various unit; the chart can also be examined in more detail to find such information as the particular skills each child in the class is working on.

As shown on the student progress profile chart in Figure 11, John S. successfully passed Unit 1 of the Quantification Skills Curriculum when pretested. He also passed Objectives A, B, G, H, and I of Unit 2, but had to work on Objectives C, D, E, and F. According to the record, he completed Objectives C and D during September (as indicated by the entry filling the box (■), passed Objective E in October (as indicated by the shaded entry ◩), and is still working on F. He also took the tests for Unit 3 in September, and had to work on all the ob-

Sept. ■ Dec. ☐ March ☐ June ☐
Oct. ☒ Jan. ☐ April ☐
Nov. ☐ Feb. ☐ May ☐

QUANTIFICATION SKILLS

STUDENT PROGRESS PROFILE

CLASS _____

STUDENT NAME	UNIT 1 COUNTING AND ONE TO ONE CORRESPONDENCES (0 TO 5)	UNIT 2 COUNTING AND ONE TO ONE CORRESPONDENCE (0 TO 10)	UNIT 3 NUMERALS (0 5)	UNIT 4 NUMERALS (6 10)	UNIT 5 COMPARISON OF SETS	UNIT 6 SERIATION AND ORDINAL POSITION	UNIT 7 ADDITION AND SUBTRACTION	UNIT 8 ADDITION AND SUBTRACTION EQUATION
	A B C D E F G H I	A B C D E F G H I	A B C D E F G	A B C D E F G	A B C D E F	A B C D	A B C D E F G	A B C D E F
1 JOHN S								
2 LYNNE N								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
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Figure 11. Student Progress Profile Chart

jectives included in Unit 3. He passed all of the objectives in Unit 3 during September and October.

The **report card** is a detailed record of an individual student's progress in each of the prescriptive curricula. Information on the report card includes the objectives (e.g., the child is able to count up to five moveable objects) the child is expected to meet during the school year in a particular curriculum, the objectives the child has acquired mastery of in each curriculum, and the specific progress pattern of the individual child. Figure 12 is an example of a report card used in a PEP classroom. It shows (a) the specific skills the child has mastered prior to beginning a given unit of work, (b) the skills the child has acquired in a given curriculum during a specific reporting period and (c) the skills the child is currently working on.

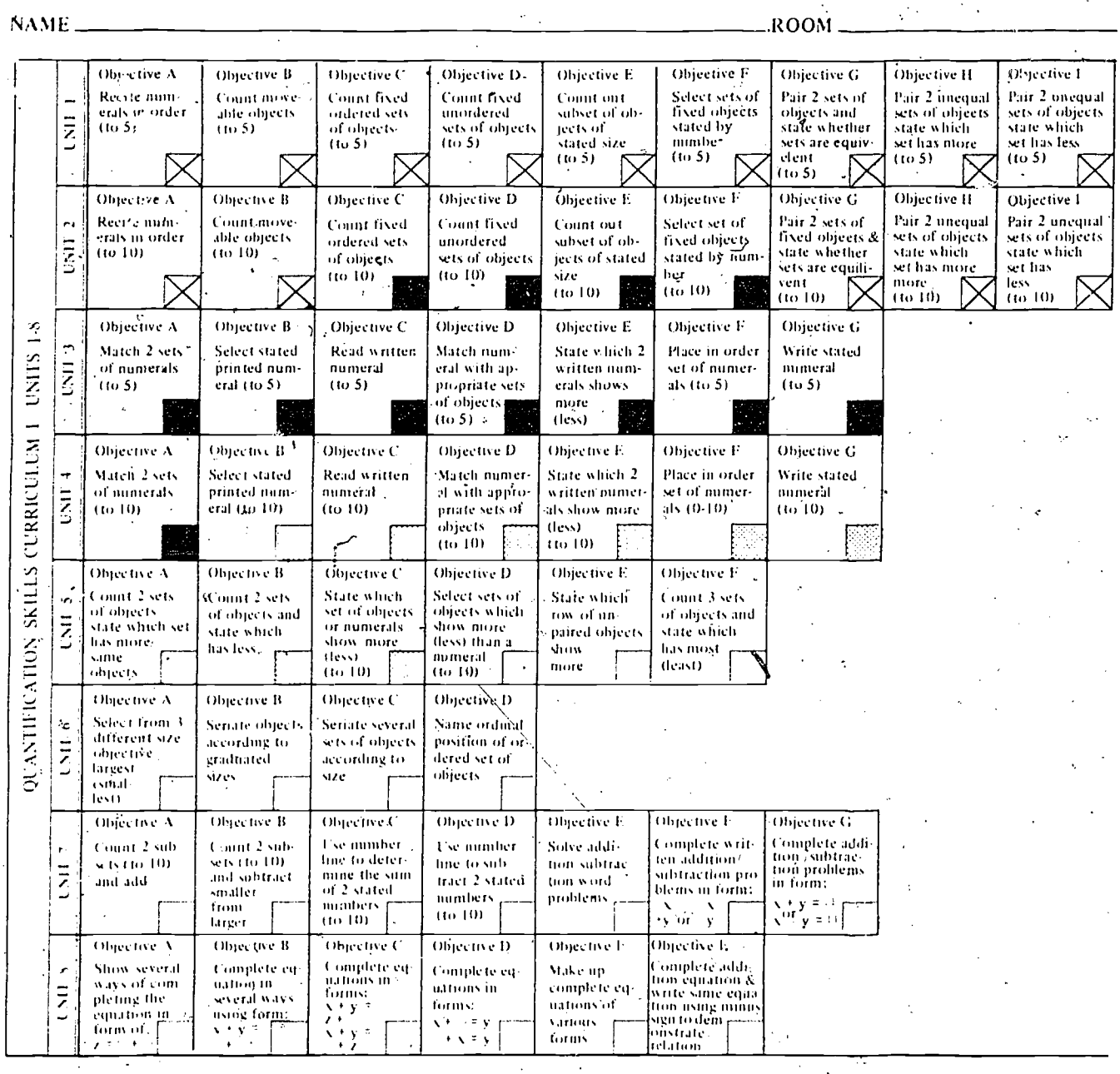

Figure 12. An example of a Report Card used in a PEP Classroom.

Figure 12 (cont'd)

QUANTIFICATION SKILLS CURRICULUM II UNITS 9-14

UNIT 9	Objective A Recite numerals in order (to 20)	Objective B Count fixed ordered set of objects (11-20)	Objective C Count fixed unordered set of objects (11-20)	Objective D Count out subset of stated numeral (to 20)					
UNIT 10	Objective A Select stated 2 digit numerals (11 - 20)	Objective B Read written numeral (11-20)	Objective C Match several sets of objects and numerals	Objective D Construct stated numeral (11-20) from array of 1-digit numerals	Objective E Write stated numeral (11-20)				
UNIT 11	Objective A Group and state how many groups of 2's, 3's, 5's (20-100 objects)	Objective B Recite numerals in order by 10's (to 100)	Objective C Group by 10's and state how many groups of 10 (20-100 objects)	Objective D Group and count set of objects to 100 by 10	Objective E Recite numerals in order to 100 by 1's	Objective F Group by 10's and state how many 10's and 1's (set of objects 100)	Objective G Group and count by 10's and 1's (100 objects)	Objective H Count set of objects to 100 by ones	
UNIT 12	Objective A Select stated 2 digit numerals (20+)	Objective B Read 2 digit numerals multiple of 10	Objective C Match set of objects and numerals (10-100)	Objective D Select stated 2 digit numeral (20 +)	Objective E Read 2 digit numerals (20 +)	Objective F Count and arrange subsets of objects indicated by 2 digit numerals	Objective G Select 2 digit numerals stated x tens and y ones	Objective H State as x tens and y ones 2 digit numerals	Objective I Construct the stated numerals x tens and y ones
UNIT 13	Objective A Read numerals in order by 100's (to 1000's)	Objective B Count array of objects by 100's	Objective C Count set of 100-1000 objects by 100's and 10's	Objective D Count sets of 100-1000 objects by 100's 10's and 1's	Objective E Count out correct subset of stated number of objects (100 +)				
UNIT 14	Objective A Read numerals 100 to 1000 by 100's	Objective B Construct stated 3 digit numerals (100 - 1000)	Objective C Read 3 digit numeral (100+)	Objective D Construct stated numeral 100 + (to 1000)					

Work your child knew when he entered the program. ☒

Skills your child learned during this report period. ■

Skills your child is now working in. ◪

COLOR CODE

1st Period - Red
2nd Period - Blue
3rd Period - Green
4th Period - Black

When a child pretests out of an objective, an ☒ is marked in the appropriate box for the objective. For those objectives that the child is working in, the teacher fills in the upper left portion of the box ◪. Upon successful completion of the tasks for an objective the entire box is filled in. If, at the end of a report period, a child is still working on a particular objective the box remains half filled. The teacher fills in the boxes with different colored ink for each report period. This makes it easy for parents and students to observe the student's progress throughout the year.

Figure 12 shows a Quantification Skills Curriculum report card for John S. It is a record of John's progress in the curriculum through the second report period of the school year. As shown in Figure 12, John initially pretested out of all objectives in Unit 1 and out of Objectives A, B, G, H, and I in Unit 2. During the first report period he worked on and completed objectives C, D, E, and F in Unit 2, all of the Unit 3 objectives, and Objectives A in Unit 4. At the end of the first report period he was working on Objective B in Unit 4. During the second report period he completed the rest of the objectives in Unit 4, pretested out of Objective A in Unit 5, completed Objective B in Unit 5, and is presently working on Objective C in Unit 5. As John progresses through the Quantification Skills Curriculum in future periods those objectives will be recorded in a similar fashion using the colors that are appropriate for that

report period.

PEP teachers who have used this particular report card have found it helpful in discussing their student's progress with parents. The report card is very explicit in communicating to parents what the child is expected to learn during the school year, what the child has accomplished, and what skills the child is working on. This report card can also be used by teachers as part of the Individual Education Program (IEP) for special education students in meeting the requirements of P. L. 94-142.

Teacher Roles

An important ingredient in effective implementation of any innovative program is the teachers' ability to use the innovative techniques and materials to provide effective schooling for their students. A major concern in developing PEP was to design implementation strategies and technical supports for teachers so that they would be able to use the program. These support systems, however, were designed only to facilitate the teacher's work and not to replace the teacher.

Although some of the instructional and classroom management competencies outlined here are specific to PEP, most are competencies required for effective implementation of any instructional program. Like all effective teachers, PEP teachers need to be skillful in both classroom management and instruction. Classroom management competencies include providing materials and equipment for the various components of the program; managing the physical arrangement, display, storage, and maintenance of materials; demonstrating and explaining rules and the use of materials; and praising or otherwise reinforcing students for appropriate self-management. Instructional skills include competencies in formal, "didactic" instruction which includes administering diagnostic tests, prescribing learning tasks, checking prescriptive assignments, giving help on them as required, and leading large or small group tutoring sessions as dictated by the various curricula and by the needs of the children. In PEP, however, informal instruction interactions with children are considered as important, if not more important, than these formal instructional interactions.

Teachers in PEP classrooms generally act in two instructional modes, the "traveling" mode and the "tutoring" mode. In the traveling mode, the teacher circulates among the children as a resource, helping them with their learning tasks, checking off their completed work, and interacting informally for management or instructional purposes, usually for quite brief periods of time. The tutoring mode, on the other hand, requires the teacher to work intensively with individuals or small groups of children to administer diagnostic tests, instruct individual children, give lessons to a small group or the entire class and work with a group of children on a special learning project. Teachers take on either of these two roles as the need arises in the classroom.

The following description should provide a more concrete understanding of how a teacher spends his or her time in a PEP classroom.

A head teacher's school day in a full-day kindergarten program

8:25 Ms. L. put up a message on the special activities bulletin board that at 10:30 Mr. S., Ernie's father, would bake bread in the cooking area. The message also stated that anyone interested in joining Mr. S. should sign his or her name on the sheet. (There were eight spaces available for signing names.) The message also included the recipe Mr. S. planned to use.

8:35 Ms. L. chatted with the students as they came into the room. For example, she inquired about Sue's new baby brother. Sue informed Ms. L. and the others that the baby was named Burt, and she and her five-year-old brother Tom were planning something special for the welcoming-home party.

8:40 As Lynn came into the room, Ms. L. told her that she was about to put a message into her slot. The message was from Ms. Wilson, the school secretary, who informed Lynn that she would be free anytime after lunch. She had invited Lynn to her office to learn how to use the laminating machine. Lynn wanted to laminate the covers for the story booklets she had made.

8:45 Ms. L. conducted the opening exercises.

9:00 Ms. L. took out some lesson materials and called Jim for a tutoring session. She worked with Jim for about 15 minutes. She then called Donna, Bill, and Skip to the math area and worked with them for about 10 minutes on some subtraction problems in the form of a group game. She continued to conduct tutoring lessons until about 10:30.

10:30 Ms. L. announced that it was milk break time.

10:32 Mr. S. arrived and asked Ms. L. if he could start his baking. Ms. L. said that the students were ready for him and wished him good luck. She also informed him that those students on the list were the ones who would be joining him.

10:42 Ms. L. began to travel around the room. The following are examples of things she did as she traveled:

Checked off work

Answered questions

Asked about the activities the children were working on

Made comments on the products

Discussed with Mr. M., the aide, what materials needed to be set up for a special social studies project

Took dictation for a student

Helped a child fix the pencil sharpener that wouldn't turn

Made reinforcing comments to students who cleaned up the paint brushes

Scratched a child's back

Fixed the cassette playback machine for a child who was having problems with it

Listened to the tape recording of a child's poem

Went to the supply room to get more construction paper

11:30 Mr. S. informed Ms. L. that they had prepared the bread dough, and that he would be back around 1:30 to bake the bread.

11:45 Ms. L. reminded the students that it was 11:45 and time for some of the students to help prepare lunch and for others to get ready for clean-up time in five minutes.

11:50 Ms. L. announced to the group that it was time to clean up for lunch.

11:55 Students gathered on the floor in the center of the room. Ms. L. began to discuss with them what they had done in the morning. Pat played the poem she had recorded for the class while waiting for others to get ready for lunch.

12:05 Ms. L. told the students to get washed for lunch.

12:10 Ms. L. went to lunch.

12:35 Ms. L. returned from lunch and began to travel among students to check work, answer questions, reinforce children for their work progress, etc. Ms. L. continued her traveling role until 2:15.

1:30 Mr. S. came back and informed Ms. L. that he was going to resume baking bread with the students, and that he also planned to discuss what he had found in his "research" on bread baking by people from different cultures. He then asked if he could borrow the globe. Ms. L. told Mr. S. that the students and the teachers couldn't wait to taste the bread.

2:15 Ms. L. discussed some project plans with four students. Some children began to pass slices of bread to the students and the teacher to sample. Ms. L. commended them on the delicious bread they had made, and reminded them to take some to the children in Room D, who were having eurythmic lessons.

2:27 Mr. S. told Ms. L. that he had enjoyed working with the children very much, and thanked her for the opportunity to work with them. Ms. L., in turn, thanked him for sharing his experiences with the children and for the delicious bread.

2:30 Ms. L. announced that it was time to clean up. She told the children at the block corner that she was very impressed with the elaborate transit system they had built, and suggested that they might want to take a picture of the structure and tomorrow to write about the system they had designed. The boys said they were going to ask Mr. M. to load the camera for them.

2:40 Ms. L. continued to check the products the students had completed or had worked on during the day, and asked questions about them.

2:45 Ms. L. read a story from a library book brought in by a student.

3:00 Ms. L. conversed with parents who came to pick up their children.

3:10 Ms. L. checked work and discussed with Mr. M. their plans for tomorrow until 3:40.

Student Roles

In contrast to more conventional elementary classrooms, in PEP classrooms students are expected to play an active role in managing their own learning. The children's responsibilities include working independently to complete the tasks prescribed by the teacher, working independently and with others to plan and complete tasks of their own choice, and making decisions about when to do what work (although the range of options and the degree of control varies from age to age and from class to class). Students take diagnostic tests, participate in tutoring sessions, and engage in group activities. They learn to take the responsibility to ask the teacher to check work, ask for help from the teacher and/or peers when needed, to participate in evaluation and planning with teachers, and to locate materials and equipment independently. They also interact with peers for a variety of reasons, including assisting each other in school related activities, as well as for social and personal purposes.

The following shows how a student might spend a morning in PEP.

A typical morning of a six-year-old in a first grade class

8:25 Orlando came into the classroom and greeted Mr. B. (a part-time instructional aide). He announced to Mr. B., "We are going to try to finish our puppet show stage today."

Before Mr. B. had a chance to respond to Orlando's announcement, Orlando walked toward Greg, who was working at a table in the math area and said, "Hey Greg, let's check to see if the posters are dry."

Greg, continuing his work in a math booklet, said, "I already checked and they are dry." (The posters had been made by the boys the day before when they announced they were going to put up a puppet show stage.)

Orlando said, "Let's go and cut the cardboard for the stage. How long will it take?"

Greg made a gesture indicating he did not know and turned to his math.

Orlando paused a moment as he scanned the room and walked to the creative arts area to check over the posters. As he examined the posters, Mr. B. stopped and said, "Those are great posters. I suppose you and Greg will decide where to put them."

Orlando replied, "We will probably do that when we finish the puppet stage. I'm waiting for Greg to finish his math so that we can start cutting the cardboard." Mr. B. and Orlando looked at the posters together and discussed the contents for a few minutes, and Mr. B. commented on how well Orlando and Greg had been working together.

8:45 Ms. F., the teacher, called the class together for the opening exercises and made announcements of special activities for the day. Orlando left the art area to join the class for the opening exercises.

8:58 Orlando walked to his storage slot, took out his prescription, and examined it. He then went to the math area and picked out a cassette tape from the cassette storage tray and his math booklet from the shelf. He then put the tape in the cassette recorder and started to do his math.

9:25 He asked Ms. F. to check his work and check off the task on his prescription ticket. He then turned to Greg and said, "Aren't you finished yet? I am already done with my math. How many more pages do you still have to do, Greg?"

Greg counted the pages and said, "Four more."

"Four more! I suppose it will take you about thirty more minutes," Orlando said, shaking his head as he took the finished cassette tape and his math booklet back to the shelf. He asked Doris, who was also returning a cassette tape to the shelf, "What are you going to do next? I am waiting for Greg to finish his math so we can start building our puppet stage. I have thirty more minutes to wait! Do you want to see the posters we made?"

Doris said, "O.K." They walked to the creative arts area together. Orlando read the sentences on the posters aloud to Doris as he showed her the posters.

Orlando asked Doris, "Do you want to play a game with me?"

Doris asked, "What kind of game?"

Orlando replied, "I don't know. Let's see. We have to choose something that we can finish in thirty minutes, because that's when Greg and I will start working on the puppet stage."

9:26 They went to the exploratory ticket board to put their name tags under the sign "conceptual game center," and then they went to the conceptual game center. They examined the games that were available at the time. Doris found one and said "Let's play this one."

Orlando agreed and took the game box from Doris and proceeded to the table. They played the game for about 15 minutes and Doris won. They put the game away and asked Mr. B. to mark their Self-Schedule tickets. Orlando commented to Mr. B., "Doris was so lucky today. Everytime she rolled the dice she got five or six points and she beat me to the stop line."

10:10 Orlando walked up to Greg as Greg announced to Orlando, "I just have to correct these two mistakes and then I am done."

Orlando was pleased and said, "I will put our name tags on the board and wait for you there."

Orlando found their name tags and placed them under the sign "construction and block building center" and then announced to Mr. B., "We are going to start now." Mr. B. said, "That's great" and then walked to the construction area with Orlando. Greg joined them shortly. Mr. B. began to inquire about the specific plans they had for designing the puppet stage. The children spent about 35 minutes working on the project. They left the area for mid-morning milk at 10:45.

11:00 After the milk break, Orlando decided to finish his other assignments next. He told Greg that he had two more prescriptions to do and would join him after he finished them.

11:20 Orlando was working on his assignment in the Classification and Communication Skills Curriculum and waiting for Ms. F. to give him some help. He turned to Joseph and said, "I need to do one more prescription, then I am finished with all my work for today." Joseph ignored his comments and kept on working with his counting task.

11:22 Orlando discussed his work plans with Ms. F. Ms. F. showed the math test results to Orlando and explained what particular skill in math he needed to work on in that unit.

11:25 Orlando joined Greg to finish the work on the puppet stage.

11:40 Orlando and Greg were painting the cardboard puppet stage when Mr. B. announced, "It's clean-up time." They continued painting until Ms. F. reminded them that it was clean-up time and that they could finish their work tomorrow.

11:50 Ms. F. began to talk with the group about what they had done that morning. She asked various children to show or describe the work they had done, and then she made comments about them. One child read the story he wrote, Orlando and Greg showed their posters, etc. Ms. F. also asked individual students about their plans for the afternoon.

RESEARCH ON PROGRAM EFFECTS

Evaluation of program effects has been an ongoing research activity throughout the development and field testing of PEP. The primary purpose of this evaluation has been to obtain feedback that would enable us to revise the program. Evaluation research related to the development of PEP has included (a) validation studies of the curriculum content and procedures for diagnostic testing and classroom management, (b) documentation of teacher and student behaviors, and (c) investigations of student learning outcomes. The following sections provide a brief discussion of selected aspects of this research to provide program users with some general information about the empirical base upon which PEP was developed and refined.

The Development and Validation of Curriculum Hierarchies

The development of the basic skills curricula included in PEP generally began by identifying an extended set of competencies in a given area as the target behaviors that curriculum would teach. For example, eight behaviors, including counting and one-to-one correspondence from 0-5 and 6-10, recognition of numerals 0-5 and 6-10, comparison of sets, seriation and ordinal positions, addition and subtraction of single digits, and addition and subtraction equations using single digits were identified as target behaviors for Part I of the Quantification Skills Curriuclum.

After the target behaviors were identified, hierarchies of behaviors that would lead to the acquisition of the target behaviors were developed. Developing these hierarchies required an analysis that yielded explicit descriptions of the operations to be performed as the learner acquired the target behaviors, and the cognitive demands placed on the learner as the task was performed (Resnick, Wang, & Kaplan, 1973).

Figure 13 shows an example of the results of such analysis. Listed in the top box of the hierarchy chart shown in Figure 13 is the target behavior, "Given a numeral (0 to 5) and several sets of fixed objects, the child is able to identify the set with the number of objects indicated." The behaviors listed below the target behavior on the hierarchy have been identified as prerequisite to the acquisition of the target behavior. Each box in Figure 13 defines a task. The entry above the line describes the stimulus situation, while the entry below the line describes the response. Defining each task in this fashion assures that each box in the analysis will contain a behaviorally defined task, that is, one that can be tested by direct observation. The simpler behaviors, in our analysis, appear at the bottom of the chart, and the more complex behaviors appear toward the top. Figure 13 shows that objective B is considered prerequisite to both objectives C and E. Objective F is shown as having two prerequisites, objectives D and E.

Empirical validation of the learning hierarchies was the next in our design work. This validation was concerned with the interdependence of behaviors included within each unit of instruction, and the hierarchical order of the units (Wang, Resnick, & Boozer, 1971; Wang, 1973a). Empirical evidence of the interdependencies of the behaviors was obtained by tests designed to assess the presence and absence of each of the behaviors included in a given

QUANTIFICATION UNIT 1 - Counting and One-to-One Correspondence to 5

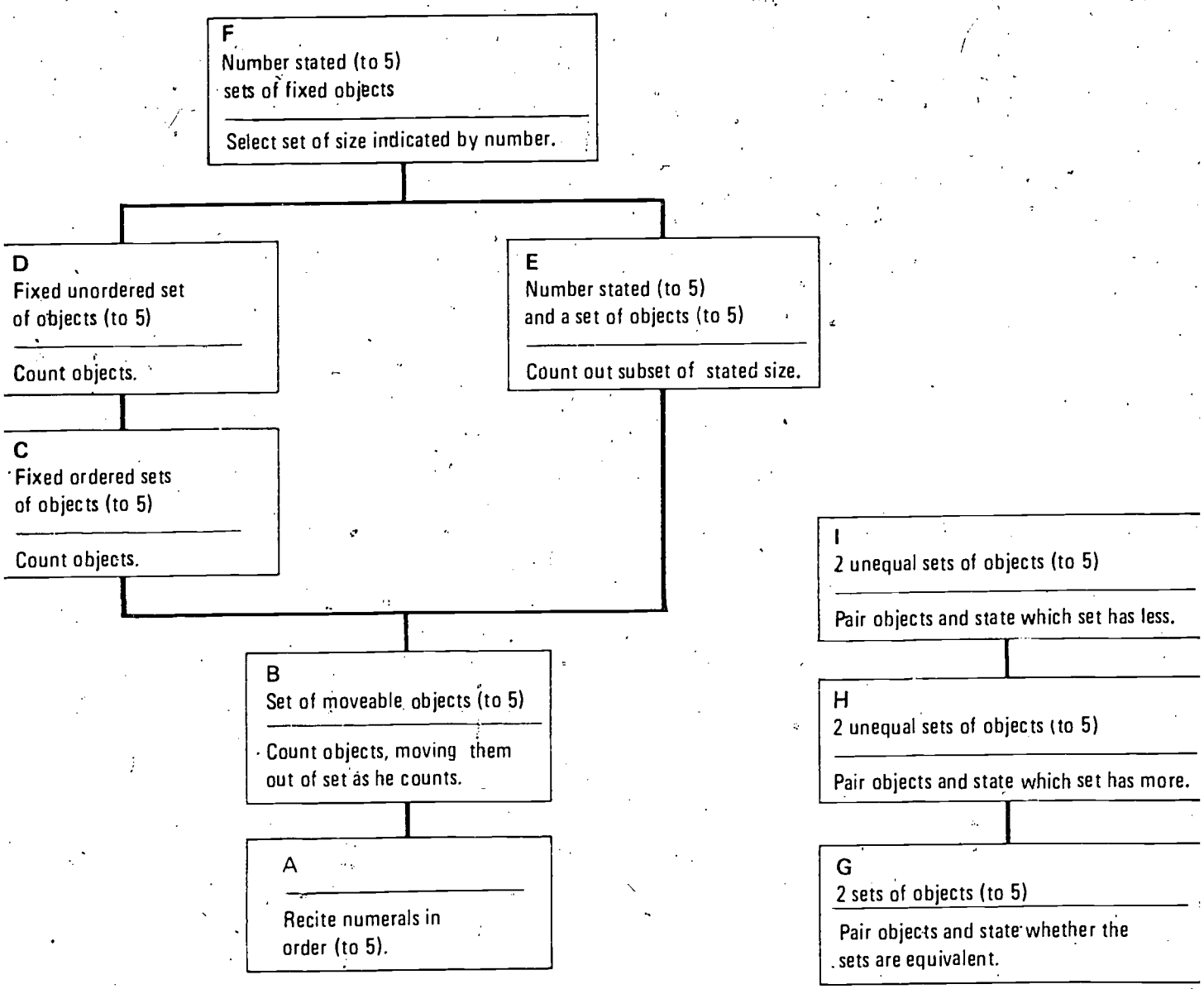

Figure 13. A Curriculum Hierarchy Chart

learning hierarchy. The test scores were then examined to determine their dependencies, that is, the extent to which passing one test reliably predicted passing all objectives below it in the hierarchy. Results of these studies provided an empirical base from which descriptive statements about the curriculum structure were made.

The Evaluation of PEP's Diagnosis-Prescription Approach

A basic approach of PEP is to diagnose children's present competencies and learning needs by means of tests, and to prescribe learning tasks for them on the basis of the results of these tests. To examine the utility of this approach to individualized instruction, a series of descriptive and experimental studies was conducted. One of these (Wang, Resnick, & Scheutz, 1970), an observational study, documented the nature of teacher and student behaviors associated with diagnostic testing, and the teacher time required to administer and to record diagnostic test results. The results of this study suggest that adopting diagnostic testing as an integral procedure in the teaching-learning process is feasible. The teachers observed were able to implement diagnostic testing as a routine classroom practice within the time constraints of a school day. Furthermore, they were able to utilize the diagnostic test information to prescribing appropriate learning experiences for individual students.

To test empirically our belief that formal diagnostic testing is required for individualizing instruction--that is, for matching a child's assignments to his or her learning needs with some precision--we investigated the extent to which a teacher could accurately assess a child's learning progress through informal interactions alone. In an experimental study, teachers were asked to predict, weekly over a three-month period, the diagnostic test results on objectives in the unit in which the child was working. The predictions were then compared to the children's actual test results. In addition, during two separate weeks, the teachers were given feedback on the accuracy of their predictions, to determine the extent to which this feedback would increase the accuracy of their predictions. The overall results of this experiment showed a wide range of variability in the accuracy of the teachers' predictions based on their nformal observations. The teachers were found to be more accurate after each feedback session, however. These two findings seemed to support the notion that formal diagnostic testing plays a critical role in PEP, although teacher observation must also play a key role. Results from these studies, along with teacher reactions to early versions of PEP, have shaped the testing procedure described in the diagnostic test manuals.

Evaluating the Self-Schedule System

Another aspect of the evaluation research carried out during the development of PEP dealt with the effects of the Self-Schedule System, the system that enables children to schedule their own activities during the school day. A series of studies (Wang, 1976b) was carried out to investigate, among other things, the effects of the Self-Schedule System on student and teacher behavior. Data for these studies included classroom observations of teachers and students, and student progress information.

We found, in general, that children and teachers using the Self-Schedule System were able to make more effective use of school time than children and teachers following a con-

ventional block schedule (where the teacher schedules perceptual skills of time during which the children all work on a particular subject-- math from 9:30 to 10:30, perceptual skills from 10:30 to 11:00, for example). Self-scheduling children completed more tasks in less time, and exhibited more purposeful and attentive behavior. The children in self-scheduling PEP classrooms spent less time waiting for teacher attention than those in PEP classrooms operating with a block schedule. We also found that the self-scheduling children worked in groups more frequently, and exhibited less disagreement with each other. Teachers in classrooms using the Self-Schedule System were observed to have more substantive interactions--those involving instruction and information exchange--as opposed to interactions that deal with behavior or the material management of materials. Teachers also uniformly reported a sense of having more time to work with and observe children when the children set their own schedules. (These findings are reported in Wang, 1976.)

Student Learning Outcomes

Data on student academic achievement were obtained from developmental classrooms where initial field testing of PEP was carried out, and from Follow Thorugh sites where some of the PEP curricular components were implemented. These data include information on student progress in the basic skills curricular and standardized achievement test results. Detailed discussions of student progress have appeared in several technical reports (Eichelberger & Boston, 1976a; Rosner, 1972; Wang, 1976a; Wang, Resnick, & Scheutz, 1970, 1974).

Student progress in the basic skills curricula. The results of PEP's diagnostic tests not only provide a basis on which teachers make assignments for children's prescriptive work; they also provide a record of children's progress in the program. For program evaluation purposes, we examined the student progress data to determne whether the program was effective in helping the students acquire mastery of the objectives, and whether experience in the program made any difference in student entering levels in subsequent school years.

Tables 2 and 3 are examples of the type of data we used to analyze student progress under PEP. Reported in the tables are summaries of student mastery in the Quantification Skills and Classification and Communication Skills curricula of the PEP classes from an inner city school. (The tables are adapted from Wang, Resnick, & Scheutz, 1974.) The tables show the percentage of children who mastered each of the units in the various curricula by the end of the school year. Table 2 shows, for example, that the typical 4-year-old could by the end of the year, perform counting, numeration, comparison of sets, and seriation; 5-year-olds advanced to units on addition and subtraction operations up to 10 by the end of the school year. A consistent pattern of student progress is clearly reflected in the data, particularly when the total number of instructional objectives (in Quantification) mastered at the beginning of the school year (entry level) and the total number mastered by the end of the school year (terminal mastery) for each age group are compared.

Standardized achievement test results. The central question in examining achievement test scores was to determine whether PEP made a difference in student achievement. The evaluation design took advantage of the fact that PEP was usually implemented first in the lowest grade of a school. Then in each succeeding year the next higher grade began to

Table 2

Percent of Students Mastering Each Unit in the Quantification and the IPI Mathematics Curriculum at End of School Year 1969-70

Unit	Age Group				
	3 yrs. N = 23	4 yrs. N = 33	Kindergarten p.m N = 56	Kindergarten a.m. N = 52	First Grade N = 133
	Quantification				
1. Counting 1-5	59	81	93	100	93
2. Counting 1-10	32	78	88	100	91
3. Numeration 0-5	36	75	88	90	93
4. Numeration 6-10	18	56	81	92	81
5. Comparison of sets	9	47	90	85	85
6. Seriation	14	34	70	77	77
7. Addition and Subtraction	5	6	49	56	83
8. Addition and Subtraction equations	---	---	12	21	28
9. Counting 11-20	5	28	58	58	93
10. Numeration 11-20	---	6	47	60	86
11. Counting 20-100	---	---	21	27	56
12. Numeration 20-100	---	---	4	10	38
13. Counting 100-1000	---	---	---	4	19
14. Numeration	---	---	---	---	15
	IPI				
Level B	---	---	---	---	4
Level C	---	---	---	---	1

Reproduced from Wang, M. C., Resnick, L. B., & Scheutz, P. R. PEP in the Frick Elementary School: Interim evaluation report 1969-70 (LRDC Publication 1974/13). Pittsburgh: University of Pittsburgh, Learning Research and Development Center, 1974.

Table 3

Student Mastery Summary
Percent of Students Mastering Each Unit of the Classification Curriculum at End of School Year 1969-70

Unit	Group			
	3-yr. old N=23	4-yr. old N = 33	Kindergarten p.m. N=56	Kindergarten a.m. N=52
	Classification I			
1. Matching	77	75	95	90
2. Simple Classification	41	66	95	94
3. Classification of objects varying in 2 dimensions	50	72	96	90
4. Color naming	41	59	91	98
5. Shape naming	41	56	88	92
6. Size description	9	25	68	73
7. Advanced classification	*	19	65	71
	Classification II			
1. Singular and plural obj.	*	19	74	75
2. Reverse order ident.	*	3	63	63
3. Prepositional statemt.	*	*	57	56
	Classification III**			
1. Multi-dimensional classification			58	71
2. Classification of functional categories			47	71
3. Category naming			53	65

* Unit not included in the curriculum for this age group.
** Classification III was not used in preschool and kindergarten.

Reproduced from Wang, M. C., Resnick, L. B., & Scheutz, P. R. PEP in the Frick Elementary School: Interim evaluation report 1969-70 (LRDC Publication 1974/13). Pittsburgh: University of Pittsburgh, Learning Research and Development Center, 1974.

use the program while the lower grades continued to use it. This implementation pattern allowed us to compare the test results of the children who used PEP with those of the children who, the year before, had used the school's previous program. For example, we would be comparing the test results of children who had been in kindergarten in 1971-72 and who used program X with those of the children who were kindergarteners in 1972-73 and used PEP. In this way, we could compare test results of children from the same neighborhood, perhaps even from the same family.

The data presented below come from the Wide Range Achievement Test (WRAT), which was given at the end of the school year in our field test schools. It was also used as part of the assessment battery for the evaluation of the National Follow Through Program.

Tables 4 and 5 show longitudinal comparisons of the WRAT results for PEP and non-PEP students. Table 4 shows the results from a public school located in an inner city neighborhood. Although direct comparisons at each grade level were not possible from data presented in Table 4, a trend in student achievement was noted. The children in the program scored above the national norm in subject areas covered, while children not in the program were substantially below the national norm in all areas.

Table 4

Summary of WRAT Results (Grade Equivalent of Mean Scores)

Reading	Preschool			1-0	K-9
	Kindergarten	K-7	1-0	K-9	1-2
	First		1-8	2-2	2-3
	Second		2-2	3-4	3-8
Math	Preschool			1-1	K-7
	Kindergarten	1-0	1-4	1-2	1-3
	First		2-1	2-4	2-4
	Second		2-3	2-6	2-9

Note: Groups above the stepped line were in the Follow Through program. Groups below it were not in the program.

Table 5

Summary of WRAT* Data from One Follow Through School Mean Grade Equivalent Scores

GRADE	1971 Read.	1971 Arith.	1972 Read.	1972 Arith.	1973 Read.	1973 Arith.	1974 Read.	1974 Arith.	1975 Read.	1975 Arith.	1976 Read.	1976 Arith.	1977 Read.	1977 Arith.
Kdg.	1.0a	1.2	no data		1.0	1.0	K9	1.1	1.2	1.2	1.1	1.1	1.2	1.3
(n)	(139)b	(131)			(52)	(52)	(44)	(44)	(40)	(40)	(40)	(40)	(40)	(40)
First	1.4	1.7	1.9	2.0	1.9	2.0	2.2	2.0	2.1	2.3	2.4	2.2	2.2	2.3
(n)	(138)	(132)	(150)	(149)	(57)	(57)	(44)	(44)	(42)	(42)	(43)	(43)	(30)	(30)
Second	2.4	2.2	2.5	2.4	2.8	2.6	2.9	2.9	3.1	2.8	3.5	3.0	3.6	2.8
(n)	(71)	(73)	(149)	(149)	(145)	(148)	(43)	(42)	(44)	(44)	(41)	(32)	(32)	(32)
Third	3.0	3.0	3.2	3.1	3.5	3.1	4.2	3.4	3.8	3.4	4.2	3.3	4.5	3.4
(n)	(81)	(58)	(82)	(82)	(150)	(150)	(44)	(44)	(42)	(42)	(43)	(43)	(38)	(38)

*WRAT is Given by LRDC through local administrators in Spring of each year.

a - 1.0 Grade Equivalent Score

b - (139) Number Students Tested

Note: Groups above the stepped line were in the Follow Through program. Groups below it were not in the program.

This same trend in student achievement was observed in the LDRC Follow Through sites where PEP was used. The WRAT data from one Follow Through school are summarized in Table 5 for illustrative purposes. Data displayed in Table 5 include WRAT results from the initial year, 1973-74, through the 1976-77 school year. The overall results show that the mean grade equivalent scores for all Follow Through groups were close to, or above, the national norm, reflecting the positive impact of the program on student achievement. When comparing the achievement scores of the Follow Through and non-Follow Through groups in the same school system, the impact of the program is even more evident. As one reads across the rows in Table 5 to compare scores from the same grades across school years, a consistent pattern of difference in the achievement scores of the two groups can be observed. In all cases, scores from the Follow Through groups far exceeded those of the same age non-Follow Through groups for the preceeding year.

It is also interesting to point out that when scores for the same group are followed across the years, a pattern or progress in achievement scores can be detected. With each year of additional experience in the program, an increased gain is observed. Tracing the progress made by the kindergarten group of 1973-74 through their third grade year (1976-77), for example, students in the Follow Through program performed approximately at grade level in the spring of their kindergarten year. By spring of their first grade year they scored slightly above the grade norm in both reading (2.1 instead of the expected 1.8) and math (2.3). In the spring of 1975-76, which was their second grade year, they again scored well above grade norm in reading (3.5) and in math (3.0) (Eichelberger & Boston, 1976b). This pattern of progressive increase continued in their third grade year. Their grade equivalent scores from the spring testing of the 1976-77 school year were 4.5 for reading and 3.4 for math (Wang, Leinhardt, & Boston, in press). Thus, the more time students spend in PEP, the more they seem to gain in academic achievement.

More detailed information about the evaluation research carried out during the course of the development of PEP is given in several technical reports published by LRDC and in professional journals and books. These are listed in the Appendix.

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APPENDIX

A bibliography of technical reports related to the development and field testing of PEP carried out during the course of development of PEP.

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