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ABSTRACT

The Primary Education Project (PEP) is concerned with the development and evaluation of a model of individualized education for young children suitable for implementation in American public schools at the preschool through primary grade level. It is concerned with all aspects of school functioning: curriculum, classroom organization, teacher training and staff development, and work with parents. The PEP curricula emphasizes basic skills and concepts often measured in intelligence and aptitude tests, and includes basic perceptual-motor skills, language concepts and logical processes concepts of number as well as fundamentals of reading. (Author/DEP)

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Introduction

The Primary Education Project (PEP) is concerned with the development and evaluation of a model of individualized education for young children suitable for implementation in American public schools. The project is a joint undertaking of the University of Pittsburgh and the Pittsburgh Public Schools. The primary object of PEP is to develop an individualized early learning program to serve children from preschool through the primary grades. The PEP individualized instructional model has been under development at Frick Elementary School in Pittsburgh since September 1967. It is concerned with all aspects of school functioning--curriculum, classroom organization, teacher training and staff development, and work with parents. The instructional model incorporates both developmental work and basic research with respect to the concerns of school functioning.

Initial work in PEP has focused on the development and evaluation of hierarchically sequenced curricula which promote early and continued success in learning by assuring that key prerequisites for successive levels of achievement are established before each new step is taken. The PEP early learning curricula emphasize basic skills and concepts that underlie a variety of subject matters. These are skills and concepts

often measured in intelligence and aptitude tests, and include basic perceptual-motor skills, language concepts and logical processes, concepts of number, etc., as well as the fundamentals of reading (Resnick, 1967).

Based on the objectives specified for each of the PEP curriculum areas, criterion-referenced placement and diagnostic tests have been developed for use in a testing program designed to diagnose and monitor each child's learning progress in the PEP curriculum. In actual use in the classroom, testing is informal and individual, and continues throughout the school year, as a child completes an objective or unit of objectives, he is pretested to establish a new starting point for further work.

Instructional procedures in PEP classrooms vary according to age group. In general, the school day begins with a "prescribed learning period," in which children work on individual assignments developed for each child on the basis of placement and diagnostic tests. A variety of materials are used, some borrowed from Montessori and English infant school programs, some designed by the PEP Research and Development Staff, and many constructed by the teachers. Children are taught to follow the prescriptions with considerable autonomy, sequencing their activities, locating work materials, selecting an appropriate place to work, and requesting help as needed.

Following the prescribed learning period, there is in many classrooms an "exploratory learning period" in which children are free to choose their own tasks from a variety available in the classroom. There is no sharp time division between the two periods. Children move from one period to the other as they finish their prescribed assignments. Exploratory tasks include construction, socio-dramatic play, creative art work, science and mathematics experiments, social studies projects, writing or dictating stories, and other language arts activities. The purpose is both to permit the child to apply his basic skills in a variety of

contexts, and to stimulate interest in new kinds of learning activities. A long-range goal of the PEP research program is to investigate appropriate ways of combining prescriptive and exploratory modes of learning so as to maximize educational growth in many dimensions.

Frick School

Frick Elementary School, the developmental school for PEP, is a Pittsburgh Public School situated near the University of Pittsburgh. All of the Frick students live in the inner-city neighborhood in which the school is located. The majority of students are from economically disadvantaged families, a large proportion of them living in public housing projects within walking distance of the school. A small percentage of the Frick students are children of university faculty, staff, and graduate students, and other professional people.

Socioeconomic Data

Tables 1 to 4 summarize the socioeconomic background of the children who attended PEP classes during the 1969-1970 school year. These data were obtained from the student registration forms, which parents or guardians are required to complete in the school clerk's office when the child is enrolled. As indicated in Table 1, between 17 and 38 percent of the children come from families with no father present. There was a large difference between preschool and kindergarten children and first grade children in the percentage of fathers at home. This may be explained by the fact that a number of children of university faculty and staff members attend Frick preschool and kindergarten classes but transfer to private schools when they reach first grade.

TABLE 1

Proportion of PEP Fathers Living at Home

	Preschool	Kindergarten	First Grade	Average
Fathers at home	83.1%	75.9%	58.9%	74.2%
Fathers not at home				
Deceased	0.0	2.6	2.9	2.3
Absent	16.9	21.5	38.2	23.5

Of the children attending PEP classes, 83.8 percent were black (see Table 2). Of those fathers at home for whom information was available, the median occupation level was that of a semi-skilled worker

TABLE 2

Racial Breakdown of PEP Students

	Preschool	Kindergarten	First Grade
1. Black	78.1%	85.3%	89.9%
2. White	17.3	13.8	9.3
3 Other	4.1	0 9	0.8

(Table 3), a category which includes such occupations as machine operators, truckers, and security guards. The occupational scale is based on Hollingshead's (1949) Occupational Categories. The median educational level of these fathers was that of a high school graduate (see Table 4). The occupation and education levels are somewhat higher than might be expected in an inner-city neighborhood such as Frick's. However, it should be noted that the data are based only on those fathers who were reported to be living at home. Furthermore, even among the fathers who were reported at home, there was a large proportion for whom no information was available. It seems likely that most of these omitted cases fell in the lower educational and occupational levels.

TABLE 3

Occupational Levels of Fathers Living at Home[1]

Category	Preschool	Kindergarten	First Grade	Average
1. Executive and Professional	4.6%	4.3%	2.3%	3.8%
2. Managerial, proprietors of medium-sized businesses and graduate students	6.2	2.6	2.3	3.3
3. Minor professional and small independent businessmen	1.5	3.4	4.7	3.8
4. Clerical, sales and technicians	7.7	8.6	6.7	8.1
5. Skilled labor and services	10.8	8.6	7.8	9.0
6. Semi skilled labor	23.1	23.3	18.6	21.3
7. Unskilled labor	26.2	20.7	16.3	19.9
8. Unemployed	6.2	5.2	7.0	6.2
9. No information	13.8	23.3	34.9	24.6

[1] Figures reported in this table are based on the "fathers at home," as reported in Table 1.

TABLE 4

Educational Levels of Fathers Living at Home[1]

	Preschool	Kindergarten	First Grade	Average
1. Graduate degree	4 6%	4.3%	0.8%	2.9%
2. Graduate school	7.7	1.7	1.6	2.9
3. College graduate	.0	1.7	2.3	1.6
4. High school +	7.7	12.1	9.3	10.0
5. High school graduate	32.3	56.0	48.1	47.7
6. 9th – 12th grade	9.2	15.5	25.6	18.4
7. 7th – 9th grade	1.5	4.3	6.2	4.5
8. Below grade 6	1.5	.9	2.3	1.6
9. No information	35.4	3.4	3.9	10.3

[1]Information was not available for most absent fathers. Figures reported in this table are based on the "fathers at home," as reported in Table 1.

Description of the PEP 1969-1970 Classes

Pre-Kindergarten. There were 23 children enrolled in the two classes for three-year-olds at Frick. The school day for the three-year-olds was from 12:30 to 3:30 p.m., Monday through Thursday. The total number of children enrolled in the four-year-old program was 33. Twenty-two of the children, randomly assigned to the two classes, had had one previous year with PEP. The average teacher-child ratio for the classes was 8.25 (a teacher and a teacher's aide were present in each class of 16 or 17 children). The four-year-olds met from 8:30 a.m. to 11:30 a.m., Monday through Friday.

Kindergarten. There were six PEP kindergarten classes. Three met from 8:30 a.m. to 11:30 a.m., Monday through Thursday. Children whose fifth birthday fell on or before June 30 were assigned to the morning group, while those whose birth dates fell on or after July 1 were assigned to the afternoon group. Thus, children in the afternoon group were six months younger, on the average, than those in the morning classes.

There were a total of 56 children enrolled in the afternoon classes. Sixteen, distributed randomly among the classes, had had previous PEP experience. The afternoon groups averaged about 19 children per class. Each class had a teacher and an assistant teacher. There were a total of 52 children enrolled in the morning kindergarten class, with an average class size of 17. Twenty-five children had previous experience with the PEP program. These children were randomly distributed among the classes.

First Grade. A total of 133 children were enrolled in five first grade PEP classes at Frick. Of these, 104 had attended PEP kindergarten the previous year, while 29 were new to the program. Each class had approximately 27 pupils, a teacher, and an assistant teacher. Children were assigned to classes randomly with no ability grouping of any kind. First grade classes met from 8:30 a.m. to 3:30 p.m. (with a one-hour lunch break at noon), Monday through Friday.

The 1969-1970 PEP Curriculum

Mathematics

The PEP Quantification curriculum and the lower levels of the IPI Mathematics curriculum served as the core for the mathematics program in PEP classrooms during the 1969-1970 school year. The PEP Quantification curriculum consists of 14 units: The first 8 units are

designed to develop an operational number concept for sets up to ten, while Units 9 through 14 introduce higher numbers together with principles of grouping and place value fundamental to the decimal number system. Table 5 outlines the content of each of the 14 units. The methods used in deriving and sequencing objectives, together with a detailed rationale for Units 1-8 appear in a paper by Resnick, Wang, and Kaplan (1973). The Quantification curriculum was used in all PEP classrooms.

TABLE 5

Beginning Mathematics Program
1969-1970

Topic	Number of Objectives
Quantification	
I. Counting	
Unit 1 – counting (1-5)	9
Unit 2 – counting (6-10)	9
Unit 9 – counting (11-20)	4
Unit 11 – counting (21-100)	8
Unit 13 – counting (101-1000)	5
II. Numeration	
Unit 3 – numeration (1-5)	7
Unit 4 – numeration (6-10)	7
Unit 10 – numeration (11-20)	5
Unit 12 – numeration (21-100)	15
Unit 14 – numeration (101-1000)	12
III. Comparison of Set Size and Seriation	
Unit 5 – comparison of set size	6
Unit 6 – seriation	4
IV. Addition and Subtraction	
Unit 7 – addition and subtraction	7
Unit 8 – addition and subtraction equations	6
Total number of objectives	104

The B and C levels of the IPI (Individually Prescribed Instruction) Math curriculum were introduced to those children who completed all units in PEP Quantification. Topics included in Levels B and C of IPI Mathematics are numeration, place value, addition and subtraction, fractions, money, time, multiplication, division, systems of measurement, and geometry. Table 6 summarizes the content covered and lists the number of objectives in each unit. The IPI Mathematics curriculum is described and discussed more fully in a paper by Lindvall and Bolvin (1967).

TABLE 6

IPI Mathematics Curriculum Used in the PEP Classes at Frick
1969-1970

Unit	Topic	Number of Objectives
Level 8		
8 – 1	Numeration	10
8 – 2	Place Value	3
8 – 3	Addition and Subtraction	10
8 – 4	Fractions	2
8 – 5	Money	4
8 – 6	Time	3
8 – 7	Systems of Measurement	4
8 – 8	Geometry	2
Total Number of Objectives		38
Level C		
C – 1	Numeration	7
C – 2	Place Value	5
C – 3	Addition	5
C – 4	Subtraction	4
C – 5	Combination of Processes	6
C – 6	Fractions	4
C – 7	Money	4
C – 8	Time	2
C – 9	Systems of Measurement	2
C – 10	Geometry	2
C – 11	Special Topics	1
Total Number of Objectives		43

Classification

The PEP Classification curriculum is divided into three sections. Classification I covers the basic concepts of "same" and "different" together with color, size, and shape discrimination. Classification II includes a number of specific language objectives. Classification III covers advanced discrimination and multidimensional classification skills. Table 7 summarizes the content of the three sections of the Classification curriculum. This curriculum was used with all children in preschool and kindergarten classes, and in first grade with children identified by teachers as needing special work in these areas.

TABLE 7

Classification Program
1969-1970

Topic	Number of Objectives
Classification I	
Matching Skills	
Unit 1 – basic matching skills	5
Unit 3 – advanced matching skills	4
Discrimination Skills	
Unit 2 – shape and size discrimination	4
Unit 4 – color naming	2
Unit 5 – shape naming	2
Unit 6 – size description	4
Unit 7 – advanced discrimination skills	12
Total Number of Objectives	33
Classification II	
Identity Statements	
Unit 1 – singular and plural	4
Unit 2 – negative	3
Prepositional Statements	
Units 3 and 4 – prepositions	16
Total Number of Objectives	23
Classification III	
Unit 1 – advanced color, size and shape discrimination	9
Unit 2 – functional category discrimination	11
Unit 3 – category naming	8
Total Number of Objectives	28

Perceptual-Motor Skills

The perceptual-motor skills program used during 1969-1970 included the general motor and visual skills components of the program outlined by Rosner (1969). The general motor skills curriculum is concerned with both gross and fine motor development of the preschool child. It contains 88 objectives in eight units. The visual skills curriculum is designed to teach various discrimination tasks involving position and orientation in a spatial matrix. The program is built around a carefully graded sequence of pattern reproduction activities. There are 83 objectives in seven units. These programs were implemented in the various PEP classes on an experimental basis at different periods during the school year.

Reading

Children in PEP first grades received reading instruction using a specially designed "Early Reading Program" (ERP), followed by the McGraw-Hill Sullivan Associates' Programmed Reading Series. PEP reading instruction stressed word decoding skills. ERP teaches children skills of sounding out and blending. It involves individual tutorial sessions at the outset, with children moving gradually into small groups and then back into individual work in the Reading Series. The reading program was formally instituted in the first grade classes beginning in January 1970. Because of the tutorial nature of the program, not all children began instruction at the same time; however, virtually all children in first grade had begun work in ERP by the end of the school year. The rationale for the PEP reading program is given in a paper by Beck (1970).

Summary of Curriculum

Table 8 summarizes the core curriculum areas included for each grade level during the 1969-1970 school year.

TABLE 8

Summary of Curriculum Components Used at Each Grade Level

Curriculum Components	Preschool	Kindergarten	First Grade
1. PEP Quantification	X	X	X
2. IPI Math			Some advanced students
3. Classification	X	X	Special work for a few
4. Perceptual Skills	X*	X*	X*
5. Reading			X

*On e perimental basis

The PEP Testing Program

The PEP Testing Program, designed to assess and monitor student learning progress in each of the PEP curriculum areas, includes a placement and a diagnostic pre- and posttest battery (Wang, 1969). The placement test battery was used at the beginning of the school year to place a particular child in the sequence of instructional units included in each of the PEP curriculum areas. The placements were also administered to new students who entered the program during the school year.

The diagnostic tests were used to determine which particular sets of objectives within a unit a child needed to work on and, following instruction, whether he had mastered those objectives. After a child was placed in a given unit (based on the placement test results), the child was given the diagnostic tests for the objectives included in that unit to determine what particular objective(s) he needed to work on. During pretest and the first posttest, the child was given the diagnostic test only for the terminal objective(s) of any given unit. However, if the child failed to

pass the posttest a second time, he was given the diagnostic test for every objective included in that particular unit to determine further work in the unit. Diagnostic tests were administered to children orally and individually. Testing was carried out informally in the classroom setting by one of the adults in the classroom (the teacher or the assistant teacher). The amount of time spent on testing varied from child to child and from age group to age group. On the average, a kindergarten or first grade child took three tests per test session; sessions lasted about eight minutes for kindergarteners, and about nine minutes for first grade children (Wang & Schuetz, 1970).

Student Learning Outcomes

Two basic kinds of data are available for assessing student learning outcomes in the PEP program: (1) records of performance on the placement and diagnostic tests included as part of the various curricula; and (2) scores on standardized achievement tests administered at the end of the school year. In this section, we shall examine both of these types of data, making certain comparisons among various PEP groups and between PEP and non-PEP classes. In the following section, we examine the relationship between achievement and various possible predictors of learning success, such as socioeconomic variables, IQ, and entering performance level as measured by placement tests. We also examine here the relationship between performance on the PEP curricula and performance on standardized tests.

Learning Progress in the PEP Curricula

Mathematics. Table 9 shows the percentage of children at each age level who had mastered each unit (i.e., passed the terminal test(s) of a given unit) in the Math curriculum at the end of the school year.

TABLE 9

Percent of Students Mastering Each Unit in the Quantification and the IPI Mathematics Curriculum at End of School Year 1969-1970

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

As can be seen, there is a steady increase with age in the percentage of students mastering each unit. With respect to content mastered, Table 9 shows that almost all first-grade and about half of the kindergarten children could perform addition and subtraction operations with quantities up to ten (Unit 7); and many children were well advanced in work with higher numbers. Pre-kindergarten children worked mainly in the lower units, learning counting, numerals, and one-to-one correspondence; but, as can be seen, individual children in the three- and four-year-old groups were able to advance to addition and subtraction and work with larger numbers.

The relatively low percentage of children in preschool and kindergarten classes passing Unit 7, and especially Unit 8, reflects teachers'

decisions to let some children skip over these relatively difficult units temporarily and return to them later. A finding of this kind usually indicates some misordering in the curriculum. In this case, certain prerequisites for Unit 8 had not been adequately learned. While skipping the unit and returning later was encouraged as a means of immediate adaptation, the R & D staff has also begun to investigate and make revisions designed to correct the problem. The revisions will be incorporated in a later version of the Mathematics curriculum.

Table 10 shows the total number of instructional objectives mastered at the beginning of the school year (the entry level) and the total number of instructional objectives mastered by the end of the school year (terminal mastery) for each age group. As the table shows, there is a consistent pattern of increase with age in both the entry and the terminal levels of mastery. Figure 1 shows these results graphically.

TABLE 10

Entry and Terminal Mastery Levels in Quantification

		Number of Instructional Objectives Mastered			
		Entry		Terminal	
Age Group	N	$\bar{X}$	S.D	$\bar{X}$	S.D.
3-year-olds	23	..	..	12.09	13.17
4-year olds	33	.64	2.22	29.36	16.09
Kindergarten p.m.	56	2.70	5.78	44.19	1 23
Kindergarten a.m.	52	3.74	6.60	50.94	25.66
First Grade	133	16.98	16 07	57.80	23.65

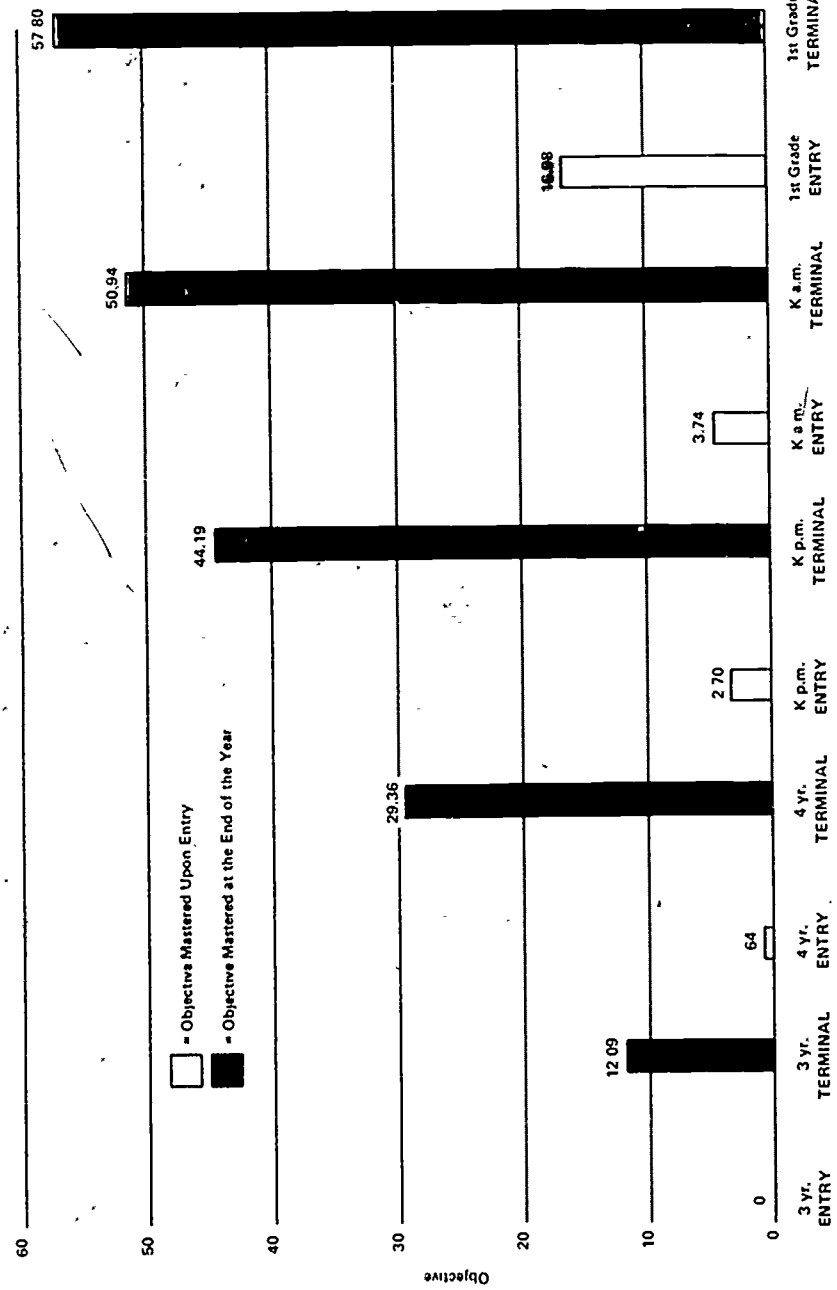

Figure 1. Student learning performance in the PEP Quantification curriculum.

One test of the effectiveness of the Quantification program comes from comparing the Fall entry level for students who had previous PEP experience with that of students who had not attended PEP classes. Table 11 shows these comparisons, giving the number of individual objectives mastered on the entering placement test for kindergarten children with and without PEP preschool and first graders with and without PEP kindergarten. As shown in Table 11, children at both grade levels who had a previous year of PEP performed significantly ($p < .01$) better on the Quantification placement tests than the new students.

TABLE 11

Comparison of the Quantification Entering Mastery Levels of the Students With and Without Prior PEP Experience Placement Test Results, Fall 1969

	Previous year in PEP		New to PEP				
Grade Level	N	Mean number of objectives mastered	N	Mean number of objectives mastered	t-test	d.f.	Significance Level
Kindergarten	41	4.98	69	2.01	2.58	108	.01
First Grade	104	18.95	29	9.90	2.92	131	.005

Classification. To examine student progress in the Classification curriculum, analyses of student learning outcome were performed similar to those described for the Quantification curricula. The results are reported in Table 12. First grade data are not included in the table because Classification was not used on a regular basis for all children at that level.

TABLE 12

Student Mastery Summary
Percent of Students Mastering Each Unit of the
Classification Curriculum at End of School Year
1969-19,0

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.

As for Classification, increase in the mastery level with age is apparent (Table 12). As an example, 50 percent of the three-year-olds mastered the unit on the classification of objects varying in two dimensions, while 72 percent of the four-year-olds and 90 percent of both kindergarten groups mastered the same unit.

A comparison was made of the entering mastery level of kindergarten children who had a year of PEP nursery school with that of the children who were new to PEP. The returning PEP students scored significantly higher ($\bar{X}$ = 11.3) than new ($\bar{X}$ = 6.94) on the Classification

placement test given at the beginning of the school year. The differences were statistically significant ($p < .0005$).

Perceptual Skills. Since the program was used with selected children and on an experimental basis, no summary data are reported here. The results from the experimental trials are reported in a paper by Rosner (1972).

Reading. Table 13 gives the percentage of first grade children who had completed each successive level of the reading program. Rather low terminal mastery levels in the reading program are a function of the late introduction of formal reading instruction during the school year.

TABLE 13

Student Mastery Summary
Percent of Students Mastering Each
Book of the McGraw-Hill, Sullivan Reading Series

Unit	Topic	Grade 1 N=133
1.	First transitional reader	64.4
2.	Second transitional reader	59.4
3.	Initial and final consonant clusters; contractions	48.9
4.	"ed" suffix of past tense verbs	40.6
5.	Inflectional and derivational suffixes "es" and "er"	31.6
6.	Inflectional and derivational suffixes "et" and "est", complex sentence structure; paragraphs	22.6
7.	New initial and final consonant clusters; suffix "ay"	13.5
8.	Short "o"; "2" and "qu"; poems, descriptive paragraphs, short stories, colon	10.5
9.	Final "y"; long "a" with final silent "e"; soft "c"	6.0
10.	Long "i" and "o"; soft "g"; longer stories	6.0
11.	Long vowels not followed by final silent "e"; long "u"	6.0
12.	Words ending in "oy" and "igh", animal sounds, concepts "bright" and "pale"	4.5
13.	"ee"; longer selections on natural sciences, with emphasis on comprehension and retention; semi colon	3.0
14.	"ew", "oo", descriptions of natural phenomena and human institutions, with emphasis on comprehension and retention	3.0
15.	"ow", "ea", "wh", "ph", silent "t" and "w", "kn", "ch"; suffixes "ture" [illegible] "ation"; months and seasons	1.5
16.	"ould", "dge", s [illegible] "l" and "h", "wr", usage of "could" "should" and "would"; history, with emphasis on comprehension and retention	1.5

Some children began work on ERP as late as April. As will be seen, the late start is also reflected in standardized achievement scores, which are low relative to mathematics scores.

Performance on Standardized Achievement Measures

So far, in this paper, we have addressed ourselves to questions related to student learning progress in the context of the PEP curriculum, using only our own criterion-referenced evaluation measures. We will now turn to the issue of how the PEP students rank in comparison with other students of their age and grade level based on national norms.

The Wide Range Achievement Test (WRAT) was selected as the standardized norm-referenced achievement test for this purpose. WRAT was chosen for the following reasons: (1) Among the available standardized tests, WRAT items, with the exception of the spelling subtest, reflect most closely the content covered by the PEP curriculum objectives--this is especially true in the lower grade levels; (2) WRAT is relatively easy to administer and the testing time required to administer the test is not extensive; (3) for longitudinal evaluation of PEP, the WRAT, a single test that covers the span from nursery through high school grades, may be a more valid test to use for the purpose of evaluating the wide range span of student learning outcomes that an individualized program such as PEP expects to achieve; (4) WRAT provides us with comparison data on a nationwide basis. (The national evaluation program for Project Follow Through also includes WRAT in its testing battery. Project Follow Through is funded by the U.S. Office of Education and PEP was selected as one of the sponsoring models.)

All three Level I subtests of the WRAT (reading, spelling, and arithmetic) were administered to all PEP kindergarten and first grade

classes in May 1970. The reading subtest requires recognizing and naming letters and recognizing words, the spelling subtest requires copying marks resembling letters, writing one's name, and writing single dictated words; and the arithmetic subtest tests counting, reading numerals, solving oral problems, and performing written computations. Specifically, to compare the content covered by the WRAT with the PEP kindergarten curriculum objectives, items included in the arithmetic subtest were directly "taught for" in the PEP kindergarten classes, and some of the reading "readiness" skills tested in WRAT were included in the PEP Classification curriculum. In first grade, both arithmetic and reading were taught, but the reading program did not begin in the first grade classrooms until late in January 1970, so that at the time the WRAT was administered the first graders had only three to four months of reading instruction. Spelling was not included in either the kindergarten or the first grade curriculum, although some of the skills included in the PEP Perceptual Skills Program were relevant to the lower level spelling tasks.

The WRAT was also administered to second and third grade classes at Frick in May 1970. These classes, none of which had previously had the PEP Program, provide a natural "control group." Since they are drawn from exactly the same neighborhood, it was assumed that second and third grade children would closely match first graders in socio-economic and other relevant student characteristics, such as ethno-cultural backgrounds.

Since the initial plan for the implementation of PEP in Frick School was designed to begin the implementation at the lowest grades (preschool and kindergarten) and move into one more grade hierarchically for evaluation purposes, the grade one year ahead of the highest PEP grade seems to be the most appropriate comparison group from a practical as well as a validity standpoint. Therefore, our evaluation plan calls

for the comparison of achievement results for the PEP classes and the non-PEP classes of the same grade level of the previous year. Unfortunately, we are not able to compare the WRAT results of the PEP first grade (1969-1970) and that of the non-PEP first grade (1968-1969), since we did not give the WRAT to the non-PEP first grade classes in 1968-1969. Nevertheless, examination of second and third grade scores for Spring 1970 provides an informal basis for assessing the power of PEP intervention.

Table 14 shows the mean raw score with standard deviation, and the mean grade equivalent for each of the WRAT subtests for PEP kindergarten and first grade children and for non-PEP second and third graders. The median gave equivalent data as shown graphically in Figure 2. As reported in Table 14, kindergarteners performed comfortably above the expected achievement of kindergarten children on both reading and arithmetic subtests (a grade equivalent of K. 9 would be just average for May of the kindergarten year). They scored about one month ahead of grade level in reading and five months ahead in arithmetic.

First graders performed about two months ahead of their grade level in arithmetic, the area in which their instructional program was best developed. In reading they performed not quite at the grade level. The grade equivalent score shows about one month behind. This result must be interpreted in the light of the late start in reading instruction in PEP classes. Instruction began in January, with many individuals beginning later, so that by the time the test was administered, children had received from zero to five months of instruction rather than the "normal" nine months. The third graders performed about nine months behind their grade level in reading. The results seem to suggest that the non-PEP classes at Erick show evidence of a developing "cumulative deficit"

TABLE 14

Wide Range Achievement Test Results
1969-1970

Class	Reading				Arithmetic				Spelling			
	N	$\bar{X}$ Raw	Standard Deviation	Mean G.E.	N	$\bar{X}$ Raw	Standard Deviation	Mean G.E.	N	$\bar{X}$ Raw	Standard Deviation	Mean G.E.
PEP:												
Kdn	103	22.04	5.10	.99	103	18 07	4.12	1.43	102	14.20	4.53	.59
1st Grade	140	34 3	10.37	1.81	140	22.35	3 24	2.14	140	20 66	4.76	1.29
NON-PEP:												
2nd Grade	110	41 39	9 54	2.33	99	23.24	2.80	2.30	89	26.55	5 09	2.01
3rd Grade	101	51.53	10 68	3.4	83	26.94	3.6	3.03	83	32.7	6.4	3.14

23

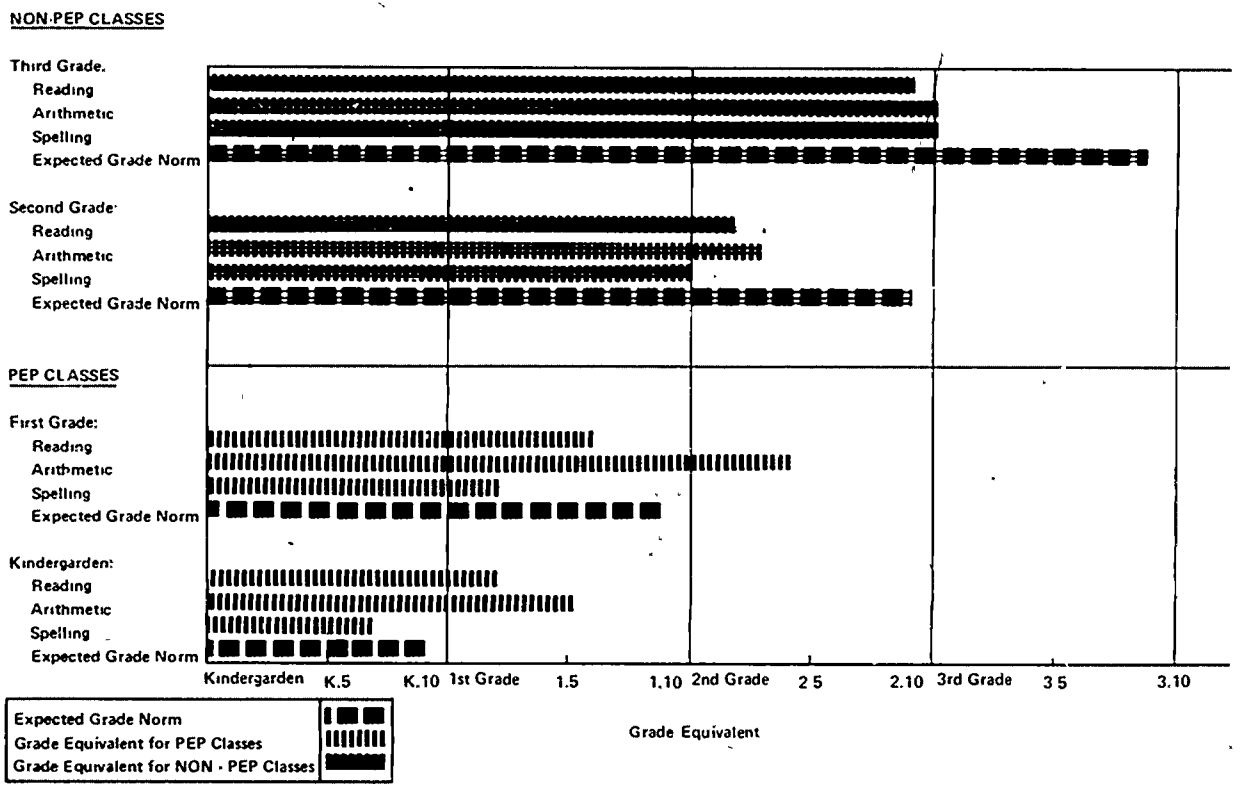

Figure 2. WRAT results for PEP and non-PEP classes. Median grade equivalent.

while PEP classes show promise of having broken the cycle by performing strongly in the first grade.

In order to be certain that the observed differences between PEP and non-PEP classes were not functions of the differences in socioeconomic status of the two groups, a comparison was made of WRAT scores of those PEP students who had siblings in the second or third grades and scores of their older siblings. Table 15 reports the mean raw score, median grade equivalent, and median percentile rank of each WRAT subtest, for each of the comparison grade levels of the 1969-1970 school year. Comparing Table 15 against Table 14, the results seemed to be substantially the same, indicating the PEP students in general scored higher on the WRAT than the non-PEP students in Frick School.

An examination of changes in scores over time should permit some assessment of the success of our development effort in improving PEP. As the PEP curriculum and its implementation are refined, scores should improve. Two years of data were available for the kindergarten, and WRAT scores for these years are compared in Table 16. For the two curricular areas included in the PEP program, arithmetic and reading (readiness), a substantial improvement from 1969-1970 is observed. However, no improvement in the spelling scores is shown. Since we did not engage in any developmental work in spelling, no improvement result was expected. In general, the effects of deliberate attention paid by the LRDC curriculum developers and the school staff to particular curriculum areas is reflected in improved achievement scores.

TABLE 15

Comparison of WRAT Results for PEP Students and Their Non-PEP Siblings
1969-1970

		Reading			Arithmetic			Spelling		
Class	N	$\bar{X}$ Raw	Median G.E.	Median Percentile Rank	$\bar{X}$ Raw	Median G.E.	Median Percentile Rank	$\bar{X}$ Raw	Median G.E	Median Percentile Rank
PEP:										
Kdg.	22	21.14	K.85	39	19.18	1.5	73	14.50	K.65	25
1st Grade	43	33.07	1.5	30	22.65	2.2	50	19.93	1.1	16
Non-PEP:										
2nd Grade	39	41.69	2.1	23	23.00	2.2	21	26.21	1.8	16
3rd Grade	26	51.65	3.1	28.5	27.25	3.0	25	34.42	3.0	27

TABLE 16

Comparison of WRAT Achievement of the
1968-1969 and the 1969-1970 Kindergarten Classes

Group	N	WRAT			PEP Curriculum Mastery Level	
		Reading	Arithmetic	Spelling	Quantification	Classification
1968-1969	120	0.7	1.0	0.7	28.12	25.61
1969-1970	103	1.0	1.4	0.6	47.57	53.46

General Discussion

Results from this second year of the PEP program at Frick School offer grounds for considerable optimism concerning the effectiveness of the general approach of the project. Children in the program are, considered on the average, clearly mastering the curriculum objectives developed for them. Comparisons with older children in the same school suggest marked progress toward breaking the cycle of "cumulative deficit" that is typically found among children of poor and minority background. In general, children using the PEP curricula have median grade equivalent scores above those expected for their age; children not using the curricula have median scores below those expected for their age. The general finding is, then, that the preschool kindergarten, and first grade children at Frick are responsive to the instruction being offered. They are learning what they are taught, and their performance compares favorably with the comparison groups identified for the study.

A particular pattern in the data should be noted and considered at this point. This is the fact that improvement in learning appears to be highly specific to the areas in which direct instruction was received. This specificity effect is seen in several places. The mean WRAT scores for spelling, for example, were low for the PEP children as well as their non-PEP older siblings and neighbors. This result reflected the absence of specific instruction in spelling in the PEP program. The results also showed that the first graders did not score as high in the reading subtest as they did in the arithmetic subtest, and this reflects the late introduction of the formal reading curriculum during the first year of its use--it is a difference we hope to see reduced or eliminated as reading instruction becomes more extensive and well-implemented.

The overall results seem to indicate that PEP is successful in teaching the concepts and skills in subject areas in which it specifically offers instructions. This particular finding is encouraging. It is encouraging because we have clear evidence that poor-prognosis children can learn standard school curricula when they are systematically and carefully taught, using hierarchically organized mastery curricula. With more of this kind of teaching, we should be able to look forward to even greater student achievement. However, the lack of generality of learning to subjects not explicitly taught suggests that one of the early objectives of the PEP project (see Resnick, 1967) has yet to be met; namely, the teaching of generalized learning skills that will allow children to prosper without the support of highly structured instruction in every area of endeavor.

This finding sets a major task for future work in individualized and adaptive education: the definition of generalized skills of learning and the development of ways of teaching these skills to children of various ages. It also poses an interesting set of research questions surround-

ing the relationship of general learning abilities, or "intelligence," and school achievement in adaptive settings. Given the specificity of learning effects found here, one would expect entering performance in the instructional curricula themselves, rather than IQ or other general ability measures; to be the major determinants of end of the year learning outcomes. Some early evidence on this question is presented in another paper (see Resnick & Wang, 1974). Meanwhile, our own work and that of many of our colleagues at LRDC is increasingly directed at exploring the relationships between aptitudes and achievement in adaptive learning environments and at the development of ways of enhancing general learning abilities in young children.

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