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ABSTRACT

Whether grouping children into special classes on the basis of IQ scores is educationally defensible was investigated using 492 educable mentally retarded (EMR) students, 12-15 years of age, during two field tests (1971-73). The curriculum used was the Me and My Environment biological sciences program. The following three test instruments were developed and administered: the Cognitive Development/Problem Solving (CD/PS) Test of Developmental Level, teacher ratings of students, and student performance measures for program units 1, 2, and 4. Analysis of data was achieved through 28 regression analyses involving 17 variables such as the student performance measure, the four CD/PS subtests, six teacher ratings, demographic variables, and test class data. Results showed that it is possible to measure levels of cognitive development with the CD/PS Test without the measure of IQ. Factors of IQ, age, sex, and ethnic background accounted for little or no explained variance over seven replications. Implications included exploration of strategies such as developmental tests for assessing performance abilities of EMR children. (An appendix which comprises more than half the document contains tables of statistical data and test examples.) (MC)

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THE RELATIONSHIP OF DEVELOPMENTAL LEVEL WITH SCIENCE PERFORMANCE: A CASE FOR AN ALTERNATIVE TO IQ GROUPING OF MILDLY RETARDED CHILDREN?

by

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THE RELATIONSHIP OF DEVELOPMENTAL LEVEL WITH SCIENCE PERFORMANCE: A CASE FOR AN ALTERNATIVE TO IQ GROUPING OF MILDLY RETARDED CHILDREN?

Joe M. Steele

The study that forms the backbone of this paper involves using cognitive developmental measures and other measures of functional ability in conjunction with traditional variables in a regression analysis against student performance on a newly developed science curriculum. Seven replications of this study are reported.

The concerns underlying the paper go far beyond the study reported. They address the following questions:

1. How informative are IQ scores to teachers of EMH children?

   --Our investigations thus far suggest that they are not only uninformative but unreliable, and hence, misleading. They neither identify a child's learning problems nor do they identify which children are more able to cope with specific classroom requirements. Thus, IQ scores do not realistically enable a teacher to prescribe remedies and form sound educational expectations for the individual student.

2. Do IQ scores at least identify who will be the slowest to learn or will have the least potential for succeeding?

   --In terms of the series of studies reported here, IQ scores are neither predictive nor explanatory of variance in performance on the science materials as measured.

3. Can any educationally useful measures be found that do explain variance in performance?

   --Several meaningful measures of ability are reported herein.

4. Can teachers use this information? (Does the information make any difference in teacher's behavior towards children and is it useful in deciding what children should study or influencing their success?)

   --A definitive answer can't yet be given. This is an area of continuing study.

5. How does subject matter and type of performance assessed affect the meaningfulness of the measures we have identified?

   --This is not yet known. Others need to utilize these measures.

The major issue to which all these questions relate is this: *Is grouping of children into special classes primarily on the basis of IQ scores educationally defensible?*

--The answer we get from a variety of studies is no, it is not.

The present study tells us that for our materials and assessments, IQ is not a relevant variable. A previous study indicated that the appropriate placement of 42% of the population in 35 field test classes could be questioned. Over 40% of the IQ scores were four or more years out of date, many having been obtained when these 13-16 year-olds were eight years old or younger. (IQ scores were updated for the studies reported.) An additional concern is that EMH children tend to remain in special classes. Other concerns include the stigma associated with such placement, the widening gap between what is taught in regular and special classes over the years, the Pygmalion effect suggested by Rosenthal, the concerns about labeling raised by Mercer, and DeAvila and Havassy's notes on the cultural limitation of IQ tests. These all add fuel to the argument that IQ as a basis of labeling and grouping EMH children is not educationally defensible. The benefits do not justify the high cost in time and money required for IQ testing.

What then is an alternative to IQ grouping of children? The problem the teacher faces in any classroom, but critically in the special education class, is to discover what each child's level of functioning at a given time actually is. Only then can the learning materials be mediated to accommodate the level and rate of functioning of each child. Note that functional ability is assumed to change as a child develops and to be specific to the kind of task rather than a global measure. The intent of assessments of functional ability is to identify present capabilities. Unfortunately, actual tests of functional ability do not exist. A few are currently being developed. Little is known of the relationship of various

abilities to instructional materials in any discipline. It behooves each curriculum developer to explore the abilities judged uniquely requisite for success on specific materials and to provide the teacher with tools to make the success possible, for each student.

The purpose of the BSCS in studying science for children in special education classes is to pioneer a curriculum for doers rather than scholars. Reading, writing, and arithmetic are not the central features of this program. Instead, students do activities and experience situations to gain a practical understanding of the world around them. The materials are intended to be both functional and intellectually stimulating, but in the special education setting this means calling upon a different set of skills. What *are* these skills for the doers, that will enable them to cope with practical problems and situations in and out of school? What abilities influence the acquisition of competence in various tasks? And at what levels of functioning are the children in special classes?

Piaget's theory of cognitive development seems to offer one alternative to the use of IQ scores as a meaningful way to make judgments about what is appropriate for presentation to children and what are appropriate expectations of children at differing levels of development. The orientation provided by a cognitive developmental approach is completely different from the traditional approach. First of all, expectations of children are based on what they have done and are capable of doing rather than on what others of their age or IQ level can do. Criteria for successful performance are also based on an understanding of what is associated and appropriate for each developmental level rather than comparison with other children. Retardation is redefined in terms of developmental level and rate.

A developmental theory would also offer considerable guidance in the design of curricula. The child is considered to be an active organizer of information who uses a different process of reasoning at each stage of development. The

curricula and teacher would deal with the experiences that best provide direction and guidance in organizing the world, rather than simply bits and pieces of information judged to be needed by an adult.

Application of a cognitive developmental theory does not necessarily mean identifying and grouping children by developmental level. It does require that developmental level be assessed. The questions addressed in this paper are whether such an assessment can be accomplished economically and whether it can explain variance in performance of children. The answer to these questions is yes. Other studies not reported here support the validity of this assessment procedure. (Steele; Gray 1973b)

At this point let us shift to a description of the study and its results and then consider their implications.

METHOD

Context and Subjects

This study arises in the context of the development and evaluation of ME AND MY ENVIRONMENT, a three-year life sciences program developed specifically for 13- to 16-year-old educable mentally handicapped (EMH) children. One group of 14 classes (FT1) began field testing these materials in 1971-72. A second field test group of 21 classes (FT2) began testing revised materials in 1972-73. Table 1 provides demographic data for the 492 students in field tests 1 and 2. Almost all the children were between the ages of 12 to 15. Mean IQ for FT1 and FT2 were 67 and 68 respectively.

As performance measures were adminstered at different times and as not all classes completed all sequences of instruction, sample sizes vary for each analysis. For the 1971-72 studies, 109 students (70% of sample) in 10 classes were included in the analysis. In the 1972-73 studies the following samples were used:

	Field Test 1			Field Test 2		
	Unit 2	Unit 4 Subtest 1	Unit 4 Subtest 2	Unit 1 Subtest 1	Unit 1 Subtest 2	Unit 2
# Classes	12	11	6	14	15	16
# Students	112	101	58	144	143	180
% of Jan. 1973 enrollment in these classes	67%	63%	66%	63%	61%	73%
% of total sample	58%	52%	30%	48%	48%	60%

Instruments

The following instruments were developed for use in these studies:

1. Cognitive Development/Problem Solving (CD/PS) Test of Developmental Level
2. Teacher Ratings of Students
3. Student Performance measures for Units 1, 2, and 4.

The CD/PS test and three-fourths of the student performance measures consisted of paper and pencil multiple-choice items. Most items included drawings for concrete reference. Table 2 provides examples of the type of items used. (For information on the development of these items, see Steele, 1973.) Twenty-five percent of the performance measures were actual ratings of performance on situational tasks.

The CD/PS test consisted of twelve cognitive development (CD) and eight problem solving (PS) items. The CD items reflected the logic of a specific developmental level and were derived from previous work by Gray (1973). The PS items assessed four problem solving skills related to experiments. An ex post facto analysis of the logic of the PS items indicated they were all concrete operational exclusion type problems. Because the two cognitive development items of the exclusion type required a similar kind of inferential reasoning and seemed to require a similar problem solving skill, they were grouped with two of the problem solving items for

the analysis. Table 2 illustrates the distribution of type and level of items in the CD/PS test. This instrument has been analyzed using ordering theory (Bart 1973), a measurement model that can assess all multilinear prerequisite relationships within a set of data (Gray, 1974.) This analysis provides substantial support for the differentiation between concrete and formal levels of cognitive development and for the relationships within the various item types. The relationships within skill types of problem solving items were minimal. Analyzed as a total test, logical prerequisites were clearly shown to exist among all items. Tables 4 and 5 graphically show these relationships and provide descriptions and statistics for the four subtests derived from the CD/PS test.

The teacher Ratings of Students were based on criteria which initially were judged likely to contribute to successful performance of the science activities. These included:

1. Ability to follow directions.
2. Ability to work with a group.
3. Ability to work with hands.
4. Child's awareness of what is going on around him.
5. Child's attitude and approach to school.
6. Primary reason for child's placement in the class.

Table 6 shows the definitions for each category which were provided to teachers and lists the distribution of ratings given.

The Student Performance measures consisted of twenty-five multiple-choice test items, eight tasks requiring interpretation of pictures, and eight situational tasks resulting in teacher ratings of performance. The items were all generated as indicators of student learning in fourteen areas of content. These items were grouped into five subtests for purposes of analysis in this study. Tables 7 and 8 provide descriptions and statistics related to these tests.

In addition to the measures described, current WISC total IQ scores (or WISC equivalents), data on student age, sex, and ethnic background were provided by the schools involved.

Procedure

All student tests were administered by the classroom teacher. For the CD/PS Test, each student received a copy and responded to four practice items before answering the twenty questions. The teacher read each question and responded aloud twice and checked to see that students were on the correct page. Item 1, a conservation of liquid quantity item, was demonstrated by the teacher before students made their response. (For a study of the validity of this procedure, see Steele, 1973a.) This instrument was given in late spring and required one class period (40-50 minutes) to administer.

The student performance items were adminstered at nine intervals throughout the year as students reached appropriate points in the curriculum. Paper and pencil items were printed on student worksheets and administered in a manner similar to the CD/PS Test. Absences and turnover rate contributed to reduce the sample for which complete performance data was obtained.

Analysis

Each of the ten subtests assessing student ability or performance was analyzed using an item analysis program. Results of this study are shown in Tables 4-8. These tables also present the biserial correlations of items with total subtest scores to illustrate the homogeneity of items grouped as subtests. The data were then converted to a binary system and analyzed using the Biomed BMD02R step-wise multiple regression program. Seventeen variables were entered into each regression analysis, including the measure of performance, the four CD/PS subtests, the six teacher ratings, the four demographic variables, the particular test class, and

student absence rate during the year. As there were six separate subtests of student performance derived in 1972-73 (three for each field test group), six regression studies were performed. In addition two regression studies had been conducted on student performance data for field test 1 for the 1971-72 school year including most of the variables (with the exception of a reduced number of CD items). Thus, this paper reports on seven replication studies of the questions under investigation.

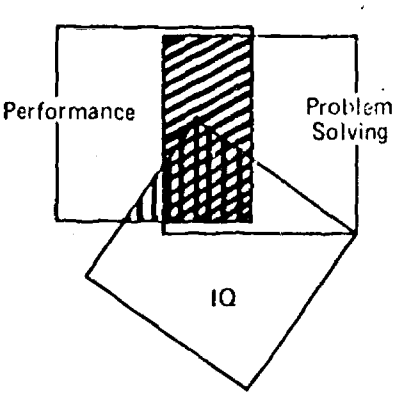
In order to avoid misinterpreting the results, a second regression analysis was conducted on each of the eight studies forcing IQ to enter the equation first rather than allowing the strongest variable to enter. This was done because the nature of this statistic is such that when two measures of the same thing are included, all of the variance will be attributed to the variable entering the equation first. The variance will not be split between the two measures. On the possibility that total IQ could be closely related to measures of cognitive development and/or problem solving, it was entered first in the second regression analysis.

Finally, as the reliability of two of the CD/PS subtests was quite low the total CD/PS Test scores ($r = .73, .72$) were used in place of the subtests for the 1972-73 data, and six regression analyses and their associated forced IQ analyses were conducted. Thus the results of a total of 28 regression analyses are reported in this paper.

RESULTS

Tables 9-18 summarize the results of the regression analyses by field test group for variables with F values significant beyond the .01 level of confidence.

What happens when IQ is forced to enter first in the regression equation? Inspecting Tables 10, 12, and 14, it can be noted that IQ explains a significant portion of the variance in six of the eight cases. However, in only two cases is the amount of variance explained larger than the additional variance explained by CD/PS variables after IQ has entered. Even in those two cases the additional variance explained by CD/PS variables is within 1-2% of the variance explained by IQ. Tables 9 and 10 can be used to discuss what is occurring, as the same condition holds for all of the other pairs of tables. In Unit I, the Problem Solving subtest entering first accounts for 37% of the explained variance. IQ entering first accounts for 17% of the variance with Problem Solving contributing an additional 22% of explained variance. The two tests were related, but not closely. The correlation of IQ with Problem Solving in this study was .47. Considered independently, the correlation of IQ with Performance was .41 compared with a correlation of .61 for Problem Solving with Performance. The interrelations of IQ, Problem Solving, and Performance on Unit I might be illustrated graphically as follows:



Shaded areas indicate variance in performance accounted for by the two measures. Problem Solving accounts for most of the variance in performance explained by IQ, but contributes a large amount of explanation not provided by IQ. Hence, the results of the first regression analyses, (Tables 9, 11, 13, 15, and 17) are the appropriate results to interpret in this study.

What follows from this conclusion combined with the results of Gray's (1974) analysis of prerequisite relationships in the CD/PS Test and Steele's (1974a) study of the validity of the items, is that it is, indeed, possible to measure levels of cognitive development. Such measures are distinct from IQ. They are economical because they can be administered to groups in paper and pencil format in a short amount of time.

The next question to review is that of the explanatory power of IQ on the performance of children using this science curriculum. A comparison of the Tables 9, 11, and 13, in which the strongest variable was allowed to enter the regression equation first reveals that in only two out of eight cases is IQ a significant variable at all, and of these, in only one case was the percent of explained variance of any magnitude. Here it contributed an additional 13% to the 25% of variance explained by CD/PS variables. Looking further at the results for demographic variables on Tables 9, 11, and 13, it can be seen that students' performance as measured on these science materials, did not depend on age or sex or ethnic background. With the one case exception for IQ, these variables do not appear to be relevant to success, at least on the ME AND MY ENVIRONMENT materials.

What is the relevance of the CD/PS subtests to performance on these science materials? In six out of eight cases, one or more of these subtests explained a major portion of the total variance explained. In three of the cases, the problem solving subtests, primarily PS 1, were the most powerful explainers. In two other

cases, the Seriation/Conservation subtest was the strongest variable. This suggests that the abilities required to succeed in these science activities are to some degree related to cognitive level of development. This point will be returned to later.

There was one other major source of explained variance in these eight studies. The teacher rating of Ability to Follow Directions was a strong contributor to explained variance in five cases. In three cases it represented the strongest variable. In addition to Following Directions, the teacher ratings of Ability to Work with Hands accounted for a moderate amount (6-7%) of explained variance in two cases. Awareness and Reason for Special Placement accounted for 6-7% of the variance in one case each.

The patterns in which these variables occurred are interesting to examine. PS 1 proved to be the strongest variable in explaining performance on Unit I for both field test groups. It may be that content and the nature of the items assessing performance were factors in this outcome. Content and the performance items again appear to be factors which may account for Following Directions being a strong variable. In two out of the three cases where it explained the greatest amount of variance, the performance items were almost all situational tasks rather than multiple choice problems. For Unit I, Subtest 2, the tasks involved actually taking measurements, grouping things or indicating compass or left-right directions. For Unit 4, Subtest 1, the tasks involved grouping or ordering things or interpreting pictures.

A discrepancy in the use of content and type of performance item to explain differences in result occurs in Unit 2. This Unit is one for which common measures are available for both field test groups. For FT1, Seriation/Conservation and IQ explained 36% of the variance. For FT2, Following Directions and Problem

Solving explained 32% of the variance. While one might argue that differences in the two field test groups must account for such a result, the lack of consistency is disconcerting and raises questions about the reliability of the instruments.

Looking at the subtests from this perspective, Formal Operations affords the least amount of explanation in the six studies in which it was used. It accounted for only 2-3% of additional explained variance. It should be remembered, however, that the difficulty of these four items ranged from 8-37% and the subtest reliability was .01 and .38. A similar situation holds true for the PS 2 subtest, which accounted for 4-9% of the variance in two of the six studies in which it was used. Item difficulties ranged from 53-72% and the reliability of this subtest was .37 and .30 in the two groups. This raises some question as to the appropriateness of treating these items as separate subtests.

What patterns of relationships exists when a total test score is derived for the CD/PS Test, rather than the four subtest scores? The reliability of the total test is .73 and .72 for field tests 1 and 2 respectively. Tables 15-18 summarize the results for the six cases. Again IQ is forced out first in one series of analyses (Tables 16 and 18) but the previous support for the first analysis still obtains. The CD/PS Test is the strongest variable in five out of the six cases, explaining from 19-24% of the variance. Following Directions is the strongest variable in the sixth case, and the second strongest variable in four of the five other cases. The case in which it is the strongest remains Unit 1, Subtest 2, which represents as assessment of ability to apply skills in situational tasks. In Unit 2, CD/PS accounts for 24% and 19% of the variance. IQ remains the second strongest variable for FT1 and Following Directions for FT2.

IMPLICATIONS

A number of implications can be drawn from this series of studies. First of all, the consistent finding that IQ, age, sex, and ethnic background account

for little or no explained variance over seven replications supports the accumulating evidence from other sources that these variables are not educationally defensible. The use of IQ scores as a basis for grouping children into special EMH classes, at least for science instruction, is highly questionable.

A second implication that seems warranted from these results is that measures of cognitive development can be economically obtained. This dimension appears to be a powerful explainer of variance in performance. It would seem appropriate to continue exploring and refining instruments that deal with cognitive development and levels of functioning. The teacher appears to be a good source for some assessments of functioning.

What are the implications of these studies for grouping? If IQ is an inappropriate strategy for grouping children, is grouping by or across developmental levels any better as an alternative? Before such a strategy can be seriously proposed, a number of questions remain to be answered:

1. What changes in CD/PS abilities occur over time for EMH and normal children?
2. How do the content and type of performance assessed relate to measures of developmental level and functional ability?
3. What explanatory power do these measures have in other subject areas or with materials utilizing a different instructional approach?
4. Will the knowledge of such results make any difference in teachers' behavior in working with EMH children?
5. Can the use of such information suggest activities and experiences that will change the pattern of performance or success of students in positive directions?

6. Will attending to functional abilities and developmental levels of children and the associated instructional responses make a difference in their lives outside the school context, i.e., will such an approach lead to more than improved academic performance?

7. What implications do measures of cognitive development have for curriculum development?

An implication that can be drawn from this list of unanswered questions is that it is premature to suggest the substitution of assessment of cognitive development (or any other measure) for IQ as a means for grouping or labelling children. What is suggested here is the exploration of such strategies. The questions listed are investigable and should yield answers.

Perhaps the measures reported in these studies can serve as the beginning of a collection of tools to assess where the child is at a point in time--his level of functioning. Perhaps the perspective of a theory grounded in a developmental psychology will promote the wise pairing of children learning together and learning from experiences appropriate for their level of understanding. Perhaps this is the appropriate grouping strategy for effective instruction.

REFERENCES

Bart, W. M. and Krus, D. J. "An Ordering-theoretic Method to Determine Hierarchies Among Items." Educational and Psychological Measurement, 1973, 33, 291-300.

Biological Sciences Curriculum Study (BSCS). ME AND MY ENVIRONMENT, Life Sciences: A Special Education Program. Boulder, Colo.: B.S.C.S., 1974.

Biological Sciences Curriculum Study Newsletter 55. ME NOW and ME AND MY ENVIRONMENT, Boulder, Colo.: B.S.C.S., April 1974.

DeAvila, E. A. and Havassy, B. Some Critical Notes on Using IQ Tests for Minority Children and a Piagetian-based Computerized Information System as an Alternative. Paper presented at the 1974 Annual Meeting of the A.E.R.A., Chicago, April 1974.

Gray, W. M. Development of a Piagetian-based Written Test: A Criterion-referenced Approach. Paper presented at the 1973 Annual Meeting of the A.E.R.A., New Orleans, February 1973 (a).

Gray, W. M. Development of a Written Test Based Upon a Model of Piaget. Final Report, September 1973 (b), University of Dayton, Project No. 2-E-052, Grant No. OEG-5-72-0044(509), National Center for Educational Research and Development.

Gray, W. M. The Integrated Cognitive Structure of EMH (Educable Mentally Handicapped) Children. Paper presented at the Fourth Special Invitational Interdisciplinary Seminar on Piagetian Theory, Los Angeles, February 1974.

Inhelder, B. and Piaget, J. The Growth of Logical Thinking from Childhood to Adolescence: An Essay on the Construction of Formal Operational Structures.

Mercer, J. Labeling the Mentally Retarded. Berkeley: University of California Press, 1973.

Rosenthal, R. and Jacobson, L. Pygmalion in the Classroom: Teacher Expectation and Pupils' Intellectual Ability. Holt, Rinehart and Winston, 1968.

Steele, J. M. "Assessment of Conservation in EMH Children." Boulder: B.S.C.S. Newsletter 50, February 1973, p. 20.

Steele, J. M. Arranging Field Tests: Characteristics of Sites and Students. ME AND MY ENVIRONMENT Formative Evaluation Report 1. Boulder: B.S.C.S., June 1973.

Steele, J. M. Assessing Student Abilities and Performance: Year 1. ME AND MY ENVIRONMENT Formative Evaluation Report 2. Boulder: B.S.C.S., December 1973.

Steele, J. M. "A Study of the Validity of the Cognitive Development/Problem Solving Test." In Assessing Student Abilities and Performance: Year 2. ME AND MY ENVIRONMENT Formative Evaluation Report 4. (In press.)

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TABLE 1

Demographic Data for Students in Field Tests 1 and 2

FIELD TEST 1 STUDENT BACKGROUND INFORMATION: YEAR 2 (AS OF JANUARY 1, 1973)

Teacher	N	Turnover Rate			Sex		Age Range in Years						Range in IQ					Mean IQ	Ethnic Composition			
		Dropped	Continuing	New	M	F	12	13	14	15	16	>16	50 & below	51-60	61-70	71-80	81 & above		White	Black	Chicano	Other
00	14	12	4	10	12	2		5		3	4	2		3	7	4		67.7	1	13		
01	18	2	13	5	9	9		8	8				3	5	3	5		61.1	11	7		
02	16	5	10	5	13	3			5	6	5			1	6	5	4	75.4	9	7		
03	9	3	6	3	5	4		1	6	2				1	8			66.4	8	1		
04	10	8	5	5	5	5	1	2	5	1	1			1	2	6	1	69.9	9		1	
05	10	9	6	4	8	2	1	5	2	2				1	4	4	1	70.1	2	8		
06	14	2	8	6	4	10	4	1	5	4				3	9	2		65.4	12	1		1*
07	16	2	13	3	12	4		2	8	6					2	9	5	77.1	16			
08	14	0	12	2	9	5		1	1	6	5	1	1	2	5	5	1	71.3	12			2**
09	14	5	10	4	8	6			1	2	3	8		3	5	5	1	68.7	14			
11	15	2	13	2	7	8			15					3	5	4	3	72.3	1	11	3	
12	17	3	13	4	9	8		2	14	1			1	2	2	9	3	72.9	12		4	1*
13	15	9	6	9	9	6	1	5	7	2				3	2	7	3	72.0	15			
14	11	19	7	4	3	8		1	2	4	3	1		3	4	3		65.7	8		3	
Total Group	193	81	126	66	113	80	7	33	79	39	21	12	5	31	64	68	22	66.8	130	48	11	4
Percent		42%	65%	34%	59%	42%	4%	17%	41%	20%	11%	6%	3%	16%	33%	35%	11%		67%	25%	6%	2%

*Oriental
**Indian

FIELD TEST 2 STUDENT BACKGROUND INFORMATION: YEAR 1 (AS OF JANUARY 1, 1973)

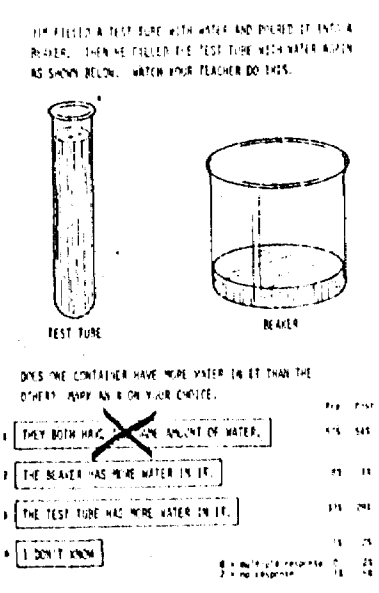
Teacher	N	Sex		Age Range in Years							Range in IQ					Mean IQ	Ethnic Composition				Location
		M	F	10	11	12	13	14	15	16	50 & below	51-60	61-70	71-80	81 & above		White	Black	Chicano or Puerto Rican	Other	
21	16	10	6		1	8	5	2					8	6		69.6	5	11			Urban
22	20	16	4		10	8	1	1				1	8	10	1	70.1	9	10	1		Urban
26	16	7	9		1	8	7					1	7	8		70.3	16				Suburban
28	9	7	2			8	1					2	5	2		67.4	8	1			Rural
29	14	8	6	2		4	4	4					3	7	4	76.1	4		10		Rural
31	12	6	6			1	8	1	1		3	1	5	1	1	62.6	3	8	1		Inner City
32	11	6	5			2	7	2			1	3	7			60.4		11			Inner City
33	12	5	7			5	5	2				3	8	1		64.1	3	2	7		Inner City
34	18	10	8			1	13						4	13	1	73.7	7		11		Urban
35	11	6	5				10	1			1	1	5	4		67.0	1	9	1		Urban
36	14	11	3			5	7	2				2	7	4	1	69.4	11	3			Smaller City
37	16	8	8		2	1	6	4	3		2	3	7	3	1	65.3	2	14			Smaller City
38	15	9	6				14	1			1	1	2	11		71.2	7	7	1		Inner City
39	17	10	7				13	4					8	9		70.2	17				Rural
41	19	13	6				9	8	2		2	4	10	2		63.2		4	15		Inner City
42	13	10	3				5	6	2			2	2	6	2	74.6	12	1			Urban
43	17	14	3			3	11	2	1				9	6		69.6		17			Urban
46	10	4	6				4	4	2		1	3	4	1		60.8	3	7			Smaller City
47	12	7	5				3	5	4			4	2	4	2	73.8	12				Suburban
48	13	7	6				5	5	1	2	3	3	7			59.6	12			1*	Smaller City
49	14	10	4			3	2	7	2				3	9	2	75.3	14				Rural
Total Group	299	184	115	2	14	57	140	60	18	2	14	34	121	107	15	68.2	142	105	47	1	
Percent		62	39%	1%	5%	19%	47%	20%	6%	1%	5%	11%	41%	36%	5%		48%	35%	16%	.3%	

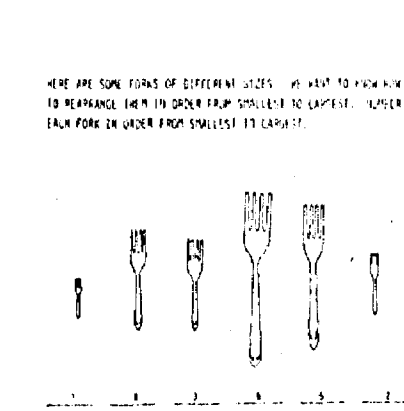
*Oriental

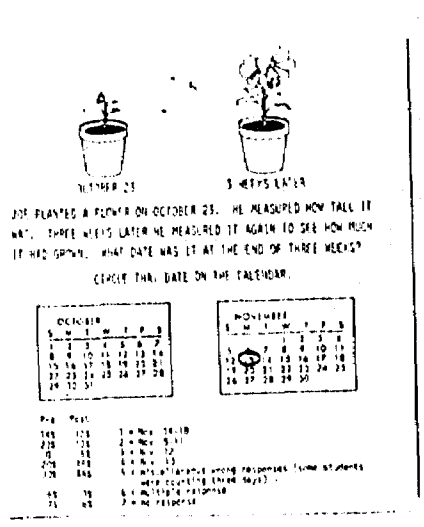
TABLE 2

Examples of Test Items Drawn From 1971-72 Studies
(Items reduced from full page size)

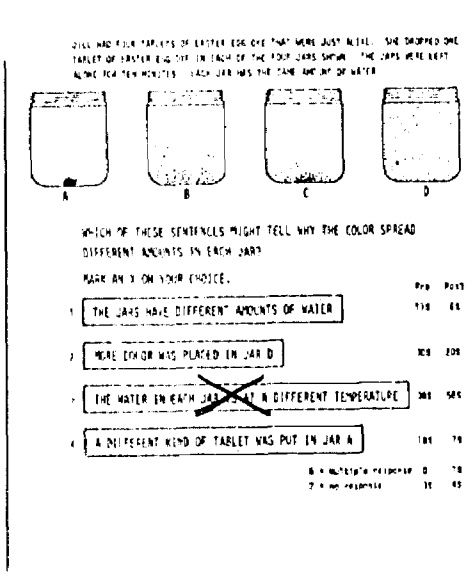
Cognitive Development items similar to items 1, 3, and 15:

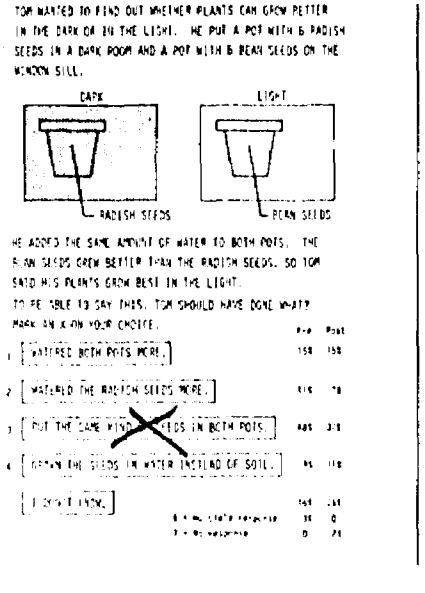




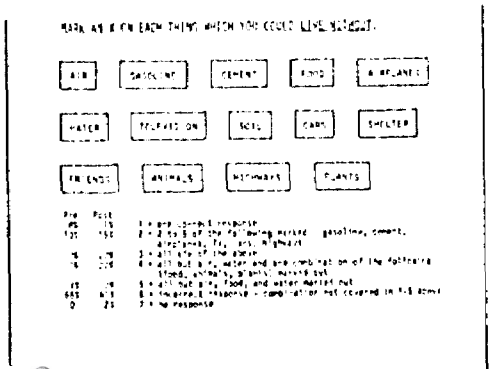


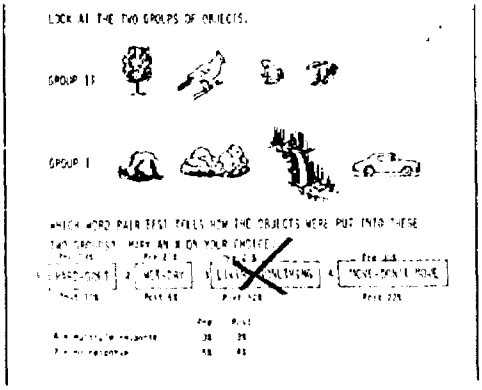
Problem Solving items similar to items 2 and 18:





Student Performance items similar to
FT2, Unit 1, Subtest 1, #12 FT2, Unit 1, Subtest 2, #10 FT1, Unit 4, Subtest 1, #7





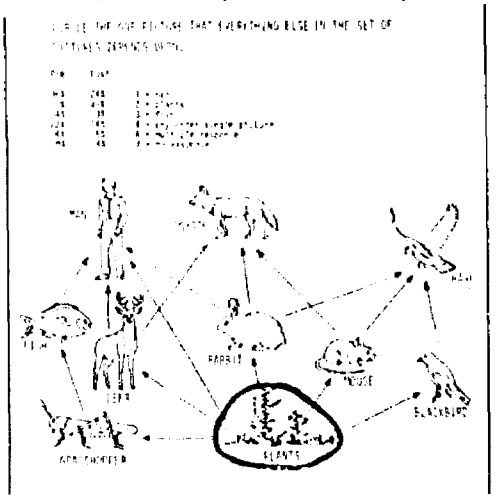


TABLE 3

Distribution of Type and Level of Items in the CD/PS Test of Developmental Level

Cognitive Development Items:

Developmental Level of Item*	Item Type				
	Transformation	Seriation	Proportion	Exclusion	Combination
C1	1, 20	3	8	10, 17	5
C2			4		9
F1		15	14		11

*C1 = Concrete 1, beginning inconsistent concrete operations
C2 = Concrete 2, established consistent concrete operations
F1 = Formal 1, a beginning level of formal operations

Problem Solving Items:

Problem Solving Skill	Item Type
	Exclusion
Knowing the question to be answered	7, 12
Knowing the experimental condition	2, 6
Recognizing conditions which might influence the results of an experiment	13, 18
Interpreting the results of an experiment	16, 19
Recognizing appropriate conclusions*	10, 17

*Recategorization of the two cognitive development exclusion type items.

TABLE 4

Cognitive Development Subtests: Descriptions and Statistics

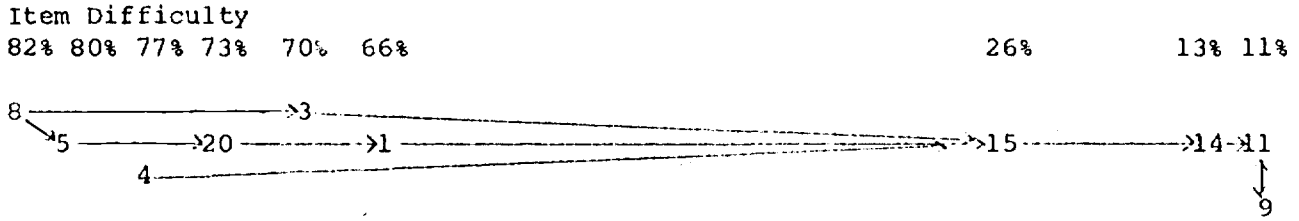
Seriation/Conservation: This subtest includes simple forms of the following types of tasks that are basic to the concrete operational stage of cognitive development.

Problem Type	Item	Percentage Correct FT1 (N=162)	Percentage Correct FT2 (N=260)	Description
Seriation:	3	73%	77%	Number each of six forks in order from smallest to largest.
Combination:	5	80%	79%	Decide how many days are needed to try out five fishing poles at the rate of one a day.
Proportion/ Exclusion:	8	83%	82%	Out of a group of four boys of different heights with different length fishing poles (ordered in the same direction as height), identify the second shortest boy with the second shortest pole.
	4	77%	78%	Out of a group of four men with different amounts of money and different sized cars (ordered in inverse relation to amount of money), identify the man who owns the smallest car and is the richest man.
Transformation:	20	79%	67%	After one bottle of root beer is poured in a tall skinny glass and another bottle of root beer is poured in a short fat glass, decide whether the tall or short glass has more in it or whether they both have the same amount.
	1	69%	66%	After a test tube is filled with water and emptied into a beaker and then the test tube is refilled with water, decide whether they both have the same amount of water or whether the beaker or test tube has more.

Formal Operations: This subtest includes the following seriation, proportion, and combination problems which require abstract thinking involving mentally sorting or manipulating numbers and groups in a systematic fashion.

Problem Type	Item	Percentage Correct FT1 (N=162)	Percentage Correct FT2 (N=260)	Description
Seriation:	15	37%	31%	Given calendars for October and November and the information that a boy planted a flower on October 23 and measured it three weeks later, determine what the date was three weeks later when he measured it.
Proportion:	14	14%	14%	Presented with pictures of three groups of children playing ball, Group A made up of 5 children and 1 ball, Group B made up of 6 children and 3 balls, decide which group to join if one wished to catch the ball most often.
Combination:	11	10%	13%	Given that each of four girls will play every other girl to find the best player, determine how many games must be played in all.
	9	8%	15%	Given that a baseball manager has three pitchers and two catchers and wants to find the best pair, decide how many pairs must be formed to give each pitcher and each catcher an equal chance.

The following prerequisite relationships hold for cognitive developmental items (at the 10% tolerance level):



Subtest Statistics:

		Seriation/Conservation			Formal Operations	
		FT1 (N=162)	FT2 (N=260)		FT1 (N=162)	FT2 (N=)
Maximum Possible Score:		13	13		8	8
Range of Scores:		0-13	0-13		0-6	0-8
Mean:		9.2	9.1		1.4	1.5
Standard Deviation:		3.1	3.3		1.4	1.8
Hoyt Reliability:		.61	.64		.01	.38
Standard Error of Measurement:		1.8	1.8		1.2	1.2
r biserial correlation with subtest score						
	Item			Item		
	8	.91	.87	15	.81	.83
	5	.96	.87	14	.81	.91
	4	.40	.55	11	.67	.84
	20	.80	.79	9	.74	.96
	3	.64	.74			
	1	.90	.89			
Percentage answering the following number of items correctly:	None	.6%	2%	None	45%	51%
	1-2	13%	11%	1	44%	31%
	3-4	17%	27%	2	10%	13%
	5-6	69%	61%	3-4	1%	5%

TABLE 5

Problem Solving Subtests: Description and Statistics

PS 1: This subtest consists of six exclusion type tasks classified at the concrete operational stage of cognitive development. The items are the same as those used during the first year of study of this population. They deal with the following three aspects of problem solving:

Problem	Item	Percentage Correct FT1 (N=162)	Percentage Correct FT2 (N=260)	Description
Knowing the Question to be Answered:	7	76%	66%	Given corn seeds planted in two pots of good soil, watered the same, having plenty of fresh air, with one pot placed in a window and the other in a dark closet, identify what the person is trying to find out: Do plants need water or sand or light or air to grow.
	12	63%	60%	Given wheat seeds planted in two pots of good soil, watered the same and placed near a window, with one plant sealed tightly in a clear jar, identify what the person is trying to find out: Do plants need good soil or water or light or air to grow.
Knowing the Experimental Condition:	2	57%	54%	Given four identical tablets of Easter egg dye dropped at the same time into four same sized jars full of water and left for ten minutes, explain why the color spread different amounts: because there were different amounts of water, more color put in one jar, water in each jar was a different temperature or different kinds of tablets were used.
	6	80%	75%	Given the conditions described in item 7 above, identify the thing that was not the same for both pots of plants: air, soil, water, light.

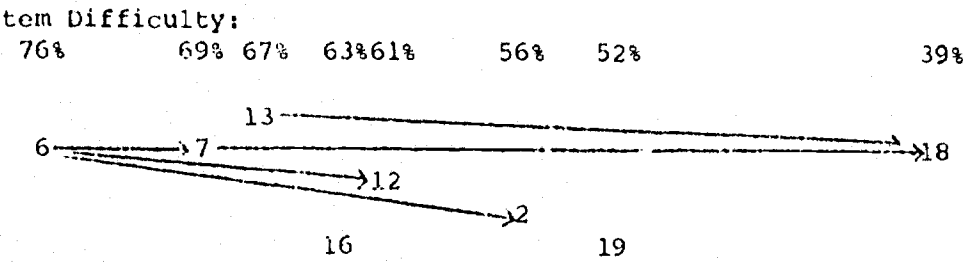
Recognizing Conditions Which Might Influence the Results of an Experiment:	13	70%	65%	Given the conditions described in item 12 above, after a few weeks the plants in the sealed jar were short and yellow but those in the open pot were tall and green. What might explain these results: The clear glass made the leaves get yellow; the plants in the jar couldn't get enough air; the plants in the jar couldn't get enough light; it was too hot near the window.
	18	49%	38%	In order to find out whether plants can grow better in the dark or in the light, a person put a pot with radish seeds in a dark room and a pot with bean seeds in the light and watered the pots the same. The bean seeds grew better than the radish seeds so the person said plants grow best in the light. To be able to say this, the person should have: watered both plants more; watered the radish seeds more; put the same kind of seeds in both pots; or grown the seeds in water instead of soil.

PS 2: This subtest consists of four exclusion type tasks classified at the concrete operational stage of cognitive development. These items deal with inferential relationships involving making judgments about the appropriateness of various conclusions drawn from a stated set of conditions.

Problem	Item	Percentage Correct		Description
		PT1 (N=162)	PT2 (N=260)	
Interpreting Results of an Experiment:	16	72%	60%	Given apples stored in a refrigerator and on a window-sill and changes observed over two weeks, conclude that apples rotted faster in the warm window-sill.
	19	56%	53%	Given weight gain in a plant with no change in the weight of soil in the pot, conclude that the plant grew bigger without using up soil.

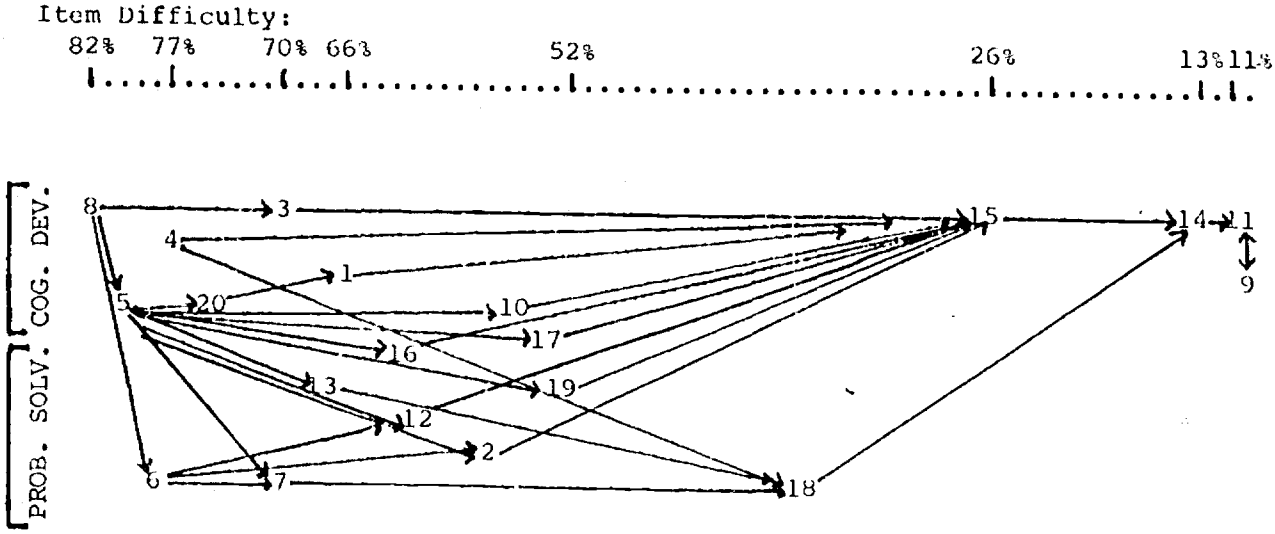
Recognizing Appropriate Conclusions:	10	56%	53%	Given that Karen weighs less than Joan and Joan weighs less than Helen, select conclusion that Karen weighs less than Helen.
	17	57%	53%	Given that Mary is shorter than Ann, Ann is shorter than Susan, and Susan is shorter than Kathy, select conclusion that Mary is shorter than Kathy.

The following prerequisite relationships hold among the problem solving items (at the 10% tolerance level):



The prerequisite relationships between problem solving and cognitive developmental items are integral and direct. Item 5 is a prerequisite for each of the problem solving items except item 18 which is linked to item 4. All of the problem solving items are prerequisites for item 15 except items 6, 13, and 18 which are prerequisites for item 14.

Analysis of Prerequisite Relationships Among Cognitive Development and Problem Solving Items (at the 10% tolerance level)



Subtest Statistics:

		PS 1			PS 2	
		FT1 (N=162)	FT2 (N=260)		FT1 (N=162)	FT2 (N=260)
Maximum Possible Score:		12	12		8	8
Range of Scores:		0-12	0-12		0-8	0-8
Mean:		7.9	7.2		4.8	4.4
Standard Deviation:		3.4	3.4		2.3	2.3
Hoyt Reliability:		.66	.62		.37	.30
Standard Error of Measure:		1.8	1.9		1.6	1.6
r Biserial Correlation with Subtest Score:	Item			Item		
	7	.91	.89	16	.73	.69
	12	.91	.80	19	.77	.68
	2	.72	.68	10	.76	.67
	6	.87	.83	17	.74	.81
	13	.83	.77			
	18	.60	.59			
Percentage answering the following number of items correctly:	None	1%	5%	None	6%	6%
	1-2	19%	22%	1	14%	23%
	3-4	34%	37%	2	31%	31%
	5-6	46%	36%	3-4	48%	40%

TABLE 6

Teacher Ratings of Students: Definitions and Statistics

Teachers were asked to rate students in their field test class on six characteristics felt to have relationships with successful performance on ME AND MY ENVIRONMENT. The task required about an hour and each rating was made on a separate sheet on which were placed the following descriptions of categories:

Rating			Percentage per Category FT1 (N=157)	FT2 (N=247)	Definition
Following Directions:	(Low)	1	9%	17%	Rate each child's ability to follow directions on a scale of 1 to 5. The higher the number, the more able the child is in carrying out a task or sequence of tasks with little supervision. Think of how much help each requires, how many times the directions must be given, and how detailed an explanation is necessary. Note that this rating involves both understanding the directions and staying with the task to do what was directed.
		2	15%	21%	
		3	29%	29%	
		4	29%	20%	
	(High)	5	18%	13%	
Working With a Group:	(Low)	1	4%	8%	Rate each child's ability to work with others in a group situation on a scale of 1 to 5. The higher the number, the more able the child is in getting along and cooperating with others in doing a task. This is a rating of social adjustment in a work situation.
		2	13%	20%	
		3	22%	19%	
		4	27%	30%	
	(High)	5	33%	21%	
Ability to Work With Hands:	(Low)	1	6%	6%	Rate each child's ability to work with his hands and manipulate things on a scale of 1 to 5. This rating includes coordination, manual dexterity, large and small muscle control. The higher the number, the more able the child is to work with his hands.
		2	9%	11%	
		3	23%	24%	
		4	29%	28%	
	(High)	5	32%	30%	
Child's Awareness of What is Going on Around Him:		1	13%	11%	Rate each child's awareness on a scale of 1 to 5. The higher the number, the more wise/aware the child. INNOCENT/UNAWARE: Doesn't see below the surface of things; usually takes things at face value; is trusting, gullible.
		2	25%	26%	
		3	3%	2%	
		4	30%	37%	
		5	27%	22%	

Rating	Percentage Per Category FT1	FT2	Definition
			This child is unaware of much that is happening around him. He has no depth of understanding. WISE/AWARE: Wise to the ways of the streets and of people; knows his way around. This child is somewhat sophisticated and aware of subtleties in what is happening around him. NOTE: Do not use category 3 unless absolutely necessary. A "3" rating will be interpreted to mean that you are uncertain how to rate this student. Category 2 indicates a degree of innocence and unawareness not as extreme as Category 1. Category 4 indicates a degree of wiseness and awareness but not as extreme as Category 5.
Attitude and Approach to School:	13%	13%	AVOIDS LEARNING: The student disregards or tries to undermine the intent of class activities. School is a game or battle with the teacher. The student might be uncooperative or disruptive.
	7%	10%	OUT OF IT: The student is inattentive and a nonparticipant. He simply is not aware of much that is going on.
	80%	76%	TRIES TO LEARN: The student is cooperative and willing; does his best and participates in class activities.
Primary Reason for Placement in Your Class:	59%	60%	TRUE RETARDATE: While the cause may not be known, the child is of low IQ and lacking in intellectual abilities; the child is mentally defective, slow-witted.
	8%	9%	EMOTIONALLY DISTURBED: The child for whatever reason exhibitis extremely neurotic or psychotic behavior. This includes extreme withdrawal as well as anxiety, uncontrolled rages and the repetitive behaviors of the schizophrenic.

Rating	Percentage Per Category FT1	FT2	Definition
	19%	18%	DISADVANTAGED: The child who has a history of severe deprivation -- of food, experience, stimulation, emotional support. Children from economically deprived settings, in free lunch programs, or whose family is on welfare sometimes fit this category.
	11%	11%	OTHER: The child may be placed in your class simply because no one else in the building can handle him. This catch-all category includes: the epileptic, physically handicapped (deaf, partially sighted, sickly), discipline problem, hyperactive, speech defective, and child with learning disabilities due to perceptual and psychomotor problems. Please give us a brief label if you check this as the basic reason for placement.

TABLE 7

Field Test I Student Performance: Description and Statistics

Unit 2: This subtest contains five multiple-choice items and a teacher rating of performance. The following two areas of understanding are assessed:

Area	Item	Percentage Correct (N=112)	Description
Microbe Needs	1	74%	Recognize at least one of the two reasons given that microbes like you: you give them warmth to grow, and you provide them a source of food and water.
	2	66%	Recognize that the explanation for microbes growing in one of two bottles of agar sealed with a bent tube may be that the bottle with microbes was not boiled or a microbe fighter was put in the other bottle.
	3	81%	Successfully complete a poster on "How to Control Microbes" including illustrations representing three or more of the categories: soap and water, cleansers or disinfectants, boiling water, covered food, covered mouth when sneezing; or a part on "Places That Microbes Live" including three or more of the categories: people, air, water, school, food, other reasonable places.
Microbe Fighters	4	90%	Recognize that the best thing to do if you think you have VD is to go to a health clinic.
	5	77%	Identify at least three of the following as microbe fighters: mouthwash, soap, toothpaste, iodine, rubbing alcohol.
	6	82%	Recognize as false at least three out of four common misunderstandings about VD, and identify as true at least three out of four accurate statements about VD.

Unit 4, Subtest 1: This subtest contains nine items assessing the following understandings:

Area	Item	Percentage Correct (N-101)	Description
Food Chains	1	77%	Supply the word Snake and Grain in the chain Hawk-_____-Mouse-_____.
	2	94%	Supply the word Grass or Grain in the chain Steer-_____.
	3	69%	Supply the words Chicken and Insects or Worms for the chain Lion-_____-_____-Grass.
	4	89%	Interpret pictures to state that energy from grass can get to a chicken through a caterpillar.
	5	61%	Interpret pictures to state that energy from a person can reach a cat by passing through a fly and a fish.
	6	62%	Interpret pictures to draw a food chain linking six animals to a plant.
Food Webs	7	77%	Recognize that a picture of a food web shows that everything depends upon plants.
	8	29%	Associate the term "food web" with a picture of a food web.
	9	54%	Given a park pond web in which fish eat mosquitos and birds eat fish, if the pond is sprayed to kill the mosquitos, choose the conclusion that fewer fish eating birds will come to the pond.

Unit 4, Subtest 2: This subtest contains eleven multiple choice items assessing the following areas:

Area	Item	Percentage Correct (N=58)	Description
Microbe Growth	1	100%	Select the refrigerator as the best place to keep milk so it won't spoil.

	2	62%	Given bread in four combinations of moisture and temperature, select "wet and warm" bread as that which would mold fastest.
	3	84%	Choose an unwrapped sandwich as the place where microbes would grow easily.
	4	78%	Identify the correct diagram that represents a cycle.
	5	74%	Shown a corked flask of grape juice with a tube running into a test tube of BTB solution, select the response that this equipment could be used to show that microbes can breath.
	6	95%	Identify which of two pictured loaves of bread was made without yeast.
	7	71%	Conclude from the breadmaking with and without yeast that some microbes help us.
Decomposition	8	78%	Select a mocassin as the thing that will decompose most easily of a pictured group of objects.
	9	84%	Select at least four out of seven correct statements as answering why garbage is a problem.
	10	52%	Choose the word "helpful" as best describing microbes that eat garbage.
	11	66%	From pictures of bottles being thrown in a garbage can, being taken to a market, being broken, and being thrown out of cars, choose taking them to a market as doing the best thing for our environment.

Subtest Statistics:

	Unit 2 (N=112)	Unit 4, Subtest 1 (N=101)	Unit 4, Subtest 2 (N=58)
Maximum Possible Score:	30	16	13
Range of Scores:	6-30	2-16	4-13
Mean:	21.7	10.3	9.9
Standard Deviation:	5.3	3.9	2.3
Hoyt Reliability:	.50	.40	.48
Standard Error of Measurement:	3.5	2.8	1.6

4 Biserial Correlation with Subtest Score:

Item		Item		Item	
1	.30	1	.49	1	--
2	.26	2	.59	2	.47
3	.81	3	.59	3	.23
4	.90	4	.63	4	.54
5	.35	5	.77	5	.80
6	.32	6	.42	6	.78
		7	.85	7	.71
		8	-.30	8	.74
		9	.99	9	.43
				10	.54
				11	.65

Percentage answering the following number of items correctly:	Unit 2 (N=112)	Unit 4, Subtest 1 (N=101)		Unit 4, Subtest 2 (N=58)	
None	0	0-2	9%	0-2	3%
1-3	13%	3-5	32%	3-7	10%
4	23%	7-8	58%	8-9	24%
5-6	64%	9	1%	10-11	62%

TABLE 8

Field Test 2 Student Performance: Description and Statistics

Unit 1, Subtest1: This subtest contains multiple choice items requiring some ability to categorize or group and deal with the following areas:

Area	Item	Percentage Correct (N=144)	Description
Senses:	1	78%	Identify the ear as the sense that would tell if all of the following were in the environment: fire siren, train whistle, jet airplane, rock music, sea shore.
Environmental Components:			Recognize as part of the environment:
	2	60%	smoke
	3	67%	music
	4	65%	garbage
	5	69%	flowers
	6	75%	people
	7	59%	clouds
	8	76%	smells
	9	58%	ants
Temperature:	10	67%	Recognize which set of temperature records were taken outdoors rather than in the classroom.
Recycle:	11	69%	Recognize an appropriate definition of the word "recycle".
Life Needs:	12	91%	Identify at least three of the following as things you could not live without: air, food, water, friends, shelter.

Unit 1, Subtest 2: This subtest contains ten items, eights of which represent performance tasks and the remainder multiple choice items. The items assess the following competencies:

Area	Item	Percentage Correct (N=143)	Description
Measurement:	1	89%	Take water temperature reading within 2° accuracy.
	2	62%	Use 12 inch ruler to measure 3 1/2" length within 1/4" accuracy.

	3	43%	Use 12 inch ruler to measure 18" length within 1/4" accuracy.
Spatial Orientation:	4	66%	Given north, correctly identify all other compass directions.
	5	70%	Locate the intersection of two streets on a map.
	6	87%	Correctly identify the left side of a worksheet.
	7	65%	Infer compass directions in a picture using cues of time of day and position of shadows.
Grouping:	8	90%	Correctly sort ten pictures into plant and animal groups.
	9	58%	Indicate some understanding of what happened in a classroom experience dealing with the categories living/nonliving.
	10	69%	Choose the appropriate labels for two sets of pictures representing the categories living/nonliving.

Unit 2: This subtest contains five multiple-choice items and a teacher rating of performance. The following two areas of understanding are assessed:

Area	Item	Percentage Correct (N=180)	Description
Microbe Needs:	1	79%	Recognize at least one of the two reasons given that microbes like you: You give them warmth to grow, and you provide them with a source of food and water.
	2	63%	Recognize that the explanation for microbes growing in one of two bottles of agar sealed with a bent tube may be that the bottle with microbes was not boiled or a microbe fighter was put in the other bottle.
	3	71%	Successfully complete a poster on "How to Control Microbes" including illustrations representing three or more of the categories: soap and water, cleaners or didinfectants, boiling water, covered food, covered mouth when sneezing;

			or a poster on "Places that Microbes Live" including three or more of the categories: people, air, water, school, food, other reasonable places.
Microbe Fighters and VD	4	92%	Recognize that the best thing to do if you think you have VD is to go to a health clinic.
	5	85%	Identify at least three of the following as microbe fighters: mouthwash, soap, toothpaste, iodine, rubbing alcohol.
	6	77%	Recognize as false at least three out of four common misunderstandings about VD, and identify as true at least three out of four accurate statements about VD.

Subtest Statistics for Field Test 2:

	Unit 1, Subtest 1 (N=144)		Unit 1, Subtest 2 (N=143)		Unit 2 (N=180)	
Maximum Possible Score:		24		50		30
Range of Scores:		3-24		5-50		0-30
Mean:		16.6		35.1		21.7
Standard Deviation:		4.7		10.4		6
Hoyt Reliability:		.48		.65		.64
Standard Error of Measurement:		3.3		5.9		3.3
r Biserial Correlation with Subtest Score:	Item		Item		Item	
	1	.52	1	.65	1	.70
	2	.52	2	.74	2	.65
	3	.56	3	.67	3	.67
	4	.64	4	.74	4	.85
	5	.61	5	.76	5	.40
	6	.52	6	.76	6	.62
	7	.70	7	.74		
	8	.52	8	.57		
	9	.59	9	.52		
	10	.62	10	.56		
	11	.76				
	12	.30				
Percentage answering the following number of items correctly:	None	0	None	0	None	1%
	1-3	17%	1-4	10%	1-3	14%
	4-8	27%	5-7	43%	4	47%
	9-12	56%	8-10	47%	5-6	38%

TABLE 9

1971-72, Field Test 1, First Analysis: Variance Accounted for in Regression Analysis, with the Strongest Variable Allowed to Enter First

VARIABLES	UNIT 1			UNIT 3		
	Step*	% Variance	F**	Step*	% Variance	F**
Functional Abilities Subtests:						
PS 1 (Problem-Solving)	1	37.0%	62.78	1	38.7%	67.41
Grouping				3	3.4%	7.08
Prerequisite Knowledge	4	4.4%	10.19	5	1.4%	3.09
Cognitive Development						
Teacher Ratings of Students:						
Following Directions	2	8.8%	17.29			
Working with a Group						
Working with Hands				2	7.3%	14.33
Aware vs. Naive				6	1.1%	2.41
Attitude Toward School						
Reason for Special Placement						
Demographic Data:						
IQ (WISC Total or Equiv.)				4	1.7%	3.64
Age				7	1.0%	2.27
Sex						
Ethnic Background						
Test Class						
Absence Rate						
Unit II (I) Performance	3	4.5%	9.61			
Variance Accounted For		55.0%			55.0%	

*Order in which variables entered the regression equation.
**F values significant at .01 for 20 and 88 degrees of freedom.

TABLE 10

1971-72, Field Test 1, Second Analysis: Variance Accounted for in Regression Analysis, with IQ Forced to Enter First

VARIABLES	UNIT 1			UNIT 3		
	Step*	% Variance	F**	Step*	% Variance	F**
Functional Abilities Subtests:						
PS 1 (Problem-Solving)	2	22.2%	38.66	2	20.9%	38.64
Grouping						
Prerequisite Knowledge	5	3.6%	8.20	6	1.6%	3.49
Cognitive Development						
Teacher Ratings of Students:						
Following Directions	3	8.4%	16.70			
Working with a Group						
Working with Hands				3	6.3%	12.85
Aware vs. Naive						
Attitude Toward School						
Reason for Special Placement	7	1.0%	2.36	7	1.3%	2.95
Demographic Data:						
IQ (WISC Total or Equiv.)	1	16.8%	21.55	1	21.7%	29.63
Age				8	1.1%	2.63
Sex						
Ethnic Background						
Test Class				5	1.8%	4.19
Absence Rate	4	4.3%	9.32			
Unit II (I) Performance	6	1.6%	3.66	4	2.4%	5.07
Variance Accounted For		58.0%			57.0%	

*Order in which variables entered the regression equation.
**F values significant at .01 for 20 and 88 degrees of freedom.

TABLE 11

Field Test 1, First Analysis: Variance Accounted for in Regression Analysis, with the Strongest Variable Allowed to Enter First

VARIABLES	Unit 2 (N=108)			Unit 4, Subtest 1 (N=100)			Unit 4, Subtest 2 (N=58)		
	Step*	% Variance	F**	Step*	% Variance	F**	Step*	% Variance	F**
Cognitive Development Subtests:									
Seriation/Conservation	1	23.3%	32.19	4	2.6%	3.39	1	18.4%	12.60
Formal Operations				3	3.3%	4.20			
Problem-Solving Subtests:									
PS 1	4	1.4%	2.42						
PS 2									
Teacher Ratings of Students:									
Following Directions				1	15.3%	17.74	2	9.7%	7.96
Working with a Group									
Working with Hands							4	6.0%	4.38
Aware vs. Naive							3	6.0%	5.33
Attitude Toward School	5	1.4%	2.36						
Reason for Special Placement	3	1.6%	2.66	2	7.0%	8.74			
Demographic Data:									
IQ (WISC total or Equiv.)	2	12.8%	20.95						
Age									
Sex									
Ethnic Background									
Test Class									
Absence Rate									
Variance Accounted For		41.0%			28.0%			40.0%	

*Order in which the variables entered the regression equation.
**F values significant at .01 for 15 and 92, 15 and 84, and 14 and 43 degrees of freedom respectively.

TABLE 12

Field Test 1, Second Analysis: Variance Accounted for in Regression Analysis, with IQ Forced to Enter First

VARIABLES	Unit 2 (N=108)			Unit 4, Subtest 1 (N=100)			Unit 4, Subtest 2 (N=58)		
	Step*	% Variance	F**	Step*	% Variance	F**	Step*	% Variance	F**
Cognitive Development Subtests:									
Seriation/Conservation	2	16.5%	27.07	2	11.1%	13.15	2	18.4%	12.47
Formal Operations				5	1.9%	2.54			
Problem-Solving Subtests:									
PS 1	4	1.4%	2.42						
PS 2									
Teacher Ratings of Students:									
Following Directions				3	4.7%	5.87	5	6.1%	5.39
Working with a Group									
Working with Hands							4	8.0%	5.27
Aware vs. Naive							3	8.1%	6.58
Attitude Toward School	5	1.4%	2.36						
Reason for Special Placement	3	1.6%	2.66	4	3.4%	4.36			
Demographic Data:									
IQ (WISC total or Equiv.)	1	19.6%	25.79	1	7.4%	7.80	1	not significant	
Age									
Sex									
Ethnic Background									
Test Class									
Absence Rate									
Variance Accounted For		40.0%			28.0%			41.0%	

*Order in which the variables entered the regression equation.
**F values significant at .01 for 15 and 92, 15 and 84, and 14 and 43 degrees of freedom respectively.

TABLE 13

Field Test 2, First Analysis: Variance Accounted for in Regression Analysis, with the Strongest Variable Allowed to Enter First

VARIABLES	Unit 1, Subtest 1 (N=138)			Unit 1, Subtest 2 (N=137)			Unit 2 (N=174)		
	Step*	% Variance	F**	Step*	% Variance	F**	Step*	% Variance	F**
Cognitive Development Subtests:									
Seriation/Conservation									
Formal Operations	5	1.8%	3.41						
Problem-Solving Subtests:									
PS 1	1	17.8%	29.34	2	4.6%	8.01	3	5.6%	14.03
PS 2	3	4.0%	7.27				2	9.1%	21.18
Teacher Ratings of Students:									
Following Directions	2	4.6%	8.01	1	18.7%	31.13	1	17.6%	36.66
Working with a Group									
Working with Hands									
Aware vs. Naive							6	.9%	2.27
Attitude Toward School							4	2.3%	5.87
Reason for Special Placement				3	1.7%	3.05			
Demographic Data:									
IQ (WISC Total or Equiv.)									
Age									
Sex									
Ethnic Background									
Test Class	6	1.8%	3.41				5	1.2%	3.01
Absence Rate	4	2.3%	4.36	4	1.7%	2.98			
Variance Accounted For		32.0%			27.0%			37.0%	

*Order in which the variables entered the regression equation.

**F values significant at .01 for 15 and 122, 16 and 120, and 15 and 158 degrees of freedom respectively.

TABLE 14

Field Test 2, Second Analysis: Variance Accounted for in Regression Analysis, with IQ Forced to Enter First

VARIABLES	Unit 1, Subtest 1 (N=138)			Unit 1, Subtest 2 (N=137)			Unit 2 (N=174)		
	Step*	% Variance	F**	Step*	% Variance	F**	Step*	% Variance	F**
Cognitive Development Subtests:									
Seriation/Conservation									
Formal Operations	7	1.8%	3.43						
Problem-Solving Subtests									
PS 1	2	14.9%	24.63	3	4.1%	7.11	4	4.9%	12.21
PS 2	4	3.9%	7.07				3	6.4%	19.78
Teacher Ratings of Students:									
Following Directions	3	4.8%	8.36	2	18.0%	29.92	2	16.7%	35.26
Working with a Group									
Working with Hands				6	1.3%	2.42			
Aware vs. Naive							7	.9%	2.41
Attitude Toward School							5	2.4%	6.29
Reason for Special Placement:				4	1.8%	3.19			
Demographic Data:									
IQ (WISC Total or Equiv.)	1	3.6%	5.06	1	not significant		1	2.4%	4.13
Age									
Sex									
Ethnic Background									
Test Class	6	1.8%	3.46				6	1.2%	3.01
Absence Rate	5	2.6%	4.82	5	1.8%	3.15			
Variance Accounted For		33.0%			28.0%			37.0%	

*Order in which the variables entered the regression equation.

**F values significant at.01 for 15 and 122, 16 and 120, and 15 and 158 degrees of freedom respectively.

TABLE 15

Field Test 1, CD/PS Total Test, First Analysis: Variance Accounted for in Regression Analysis, with the Strongest Variable Allowed to Enter First

VARIABLES	Unit 2 (N=108)			Unit 4, Subtest 1 (N=100)			Unit 4, Subtest 2 (N=58)		
	Step*	% Variance	F**	Step*	% Variance	F**	Step*	% Variance	F**
CD/PS Total Test:	1	24.0%	33.20	1	22.0%	27.68	1	20.0%	14.33
Teacher Ratings of Students:									
Following Directions				2	4.0%	4.67	2	9.0%	7.53
Working with a Group									
Working with Hands							3	6.0%	6.16
Aware vs. Naive							4	3.0%	2.63
Attitude Toward School									
Reason for Special Placement:	5	1.0%	2.34	4	2.0%	3.25			
Demographic Data:									
IQ (WISC Total or Equiv.)	2	8.0%	12.14						
Age									
Sex									
Ethnic Background	4	2.0%	3.55						
Test Class	3	2.0%	3.62	3	3.0%	4.58			
Absence Rate									
Variance Accounted For		37.0%			31.0%			40.0%	

*Order in which the variables entered the regression equation.
**F values significant for 15 and 92, 15 and 84, and 14 and 43 degrees of freedom respectively.

TABLE 16

Field Test 1, CD/PS Total Test, Second Analysis: Variance Accounted for in Regression Analysis, with IQ Forced to Enter First

VARIABLES	Unit 2 (N=108)			Unit 4, Subtest 1 (N=100)			Unit 4, Subtest 2 (N=58)		
	Step*	% Variance	F**	Step*	% Variance	F**	Step*	% Variance	F**
CD/PS Total Test:	2	13.0%	20.66	2	16.0%	20.13	2	20.0%	13.87
Teacher Ratings of Students:									
Following Directions				4	3.0%	3.61	4	8.0%	6.42
Working with a Group									
Working with Hands							3	9.0%	7.33
Aware vs. Naive							6	3.0%	2.67
Attitude Toward School									
Reason for Special Placement:	5	1.0%	2.34	5	2.0%	3.18			
Demographic Data									
IQ (WISC Total or Equiv.)	1	18.0%	23.76	1	7.0%	7.80	1	not significant	
Age									
Sex									
Ethnic Background	4	2.0%	3.55						
Test Class	3	2.0%	3.62	3	3.0%	4.43	5	3.0%	3.00
Absence Rate									
Variance Accounted For		36.0%			31.0%			43.0%	

*Order in which the variables entered the regression equation.

**F values significant for 15 and 92, 15 and 84, and 14 and 43 degrees of freedom respectively.

TABLE 17

Field Test 2, CD/PS Total Test, First Analysis: Variance Accounted for in Regression Analysis, with the Strongest Variable Allowed to Enter First

VARIABLES	Unit 1, Subtest 1 (N=138)			Unit 1, Subtest 2 (N=137)			Unit 2 (N=174)		
	Step*	% Variance	F**	Step*	% Variance	F**	Step*	% Variance	F**
CD/PS Total Test:	1	20.0%	33.46	2	4.0%	7.55	1	19.0%	39.35
Teacher Ratings of Students:									
Following Directions	2	4.0%	7.00	1	19.0%	31.13	2	9.0%	20.80
Working with a Group									
Working with Hands				4	2.0%	2.82			
Aware vs. Naive									
Attitude Toward School							3	2.0%	4.43
Reason for Special Placement:				5	1.0%	2.29			
Demographic Data:									
IQ (WISC Total or Equiv.)									
Age									
Sex									
Ethnic Background									
Test Class									
Absence Rate	3	2.0%	4.26	3	2.0%	3.19	4	2.0%	4.42
Variance Accounted For		26.0%			28.0%			32.0%	

*Order in which the variables entered the regression equation.

**F values significant at .01 for 15 and 122, 16 and 120, and 15 and 158 degrees of freedom respectively.

TABLE 18

Field Test 2, CD/PS Total Test Second Analysis: Variance Accounted for in Regression Analysis, with IQ Forced to Enter First

VARIABLES	Unit 1, Subtest 1 (N=138)			Unit 1, Subtest 2 (N=137)			Unit 2 (N=174)		
	Step*	% Variance	F**	Step*	% Variance	F**	Step*	% Variance	F**
CD/PS Total Test:	2	17.0%	28.57	3	4.0%	6.64	3	8.0%	19.81
Teacher Ratings of Students:									
Following Directions	3	4.0%	7.34	2	18.0%	29.92	2	17.0%	35.26
Working with a Group									
Working with Hands				5	2.0%	2.95			
Aware vs. Naive									
Attitude Toward School							5	2.0%	4.50
Reason for Special Placement:				6	1.0%	2.65			
Demographic Data:									
IQ (WISC Total or Equiv.)	1	4.0%	5.06	1	not significant		1	2.0%	4.13
Age									
Sex									
Ethnic Background									
Test Class							4	2.0%	4.53
Absence Rate	4	3.0%	4.73	4	2.0%	3.32			
Variance Accounted For		28.0%							

*Order in which the variables entered the regression equation.
**F values significant at .01 for 15 and 122, 16 and 120, and 15 and 158 degrees of freedom respectively.