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AUTHOR Funkhouser, Charles P.
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ABSTRACT

The focus of this study was on the expectations that first-grade teachers have of the mathematics skills of their incoming first-grade students. At the end of one school year and at the beginning of the next school year, first-grade teachers (n=64) in rural and urban settings completed the Mathematics Skills Expectations Survey (MSES). The MSES considers 11 basic areas of mathematical skills appropriate for the primary grade level and allows respondents to indicate agreement or disagreement with statements about abilities incoming first-grade students should have with respect to these skills. Data were analyzed with respect to skills clusters (numeration, arithmetic computation, measurement, symbols, and geometry) and performance vectors (written, oral, calculation, psychomotor, and visual expectations). In regard to skills clusters, teachers had highest expectations for numeration and geometry skills and lowest expectations for arithmetic computation and symbol skills. In regard to performance vectors, teachers had highest expectations for psychomotor skills and lowest expectations for calculation skills. An appendix contains the MSES questions and results of the survey. Contains 17 references. (MKR)

First Grade Teacher Expectations in Mathematics

Dr. Charles P. Funkhouser

University of Wyoming, Laramie

Running head: TEACHER EXPECTATIONS

Abstract

The focus of this study was on the expectations that first grade teachers have of the mathematical skills of their incoming first grade students. At the end of one school year and at the beginning of the next school year, sixty-four first grade teachers in rural and urban settings completed the Mathematics Skills Expectations Survey (MSES). The MSES considers eleven basic areas of mathematical skills appropriate for the primary grade level and allows respondents to indicate agreement or disagreement with statements about abilities incoming first grade students should have with respect to these skills. Data were analyzed with respect to Skills Clusters (Numeration, Arithmetic Computation, Measurement, Symbols, Geometry) and Performance Vectors (Written Expectations, Oral Expectations, Calculation Expectations, Psychomotor Expectations, Visual Expectations). Teachers had highest expectations within MSES Skills Clusters for Numeration and Geometry skills and lowest expectations for Arithmetic Computation and Symbol skills. Teachers had highest expectations for MSES Performance Vectors for Psychomotor skills and lowest expectations for Calculation skills. Recommendations and implications of this study are given which could have broad applicability to the planning of informal mathematics experiences and activities previous to children beginning first grade.

First Grade Teacher Expectations in Mathematics

The focus of this study was on the expectations that first grade teachers have of the mathematical skills of their incoming first grade students. An incoming class of first graders is very likely to come from a variety of educational, economic and social backgrounds. It is suggested by this researcher that the prerequisite mathematical skills commonly expected by students' first grade teachers would provide useful guidelines for parents, caregivers, and educators who might be involved in the first years of children's mathematical development.

Statement of the Problem

The first years of a child's education are critical to his success throughout his educational career (Carpenter, 1980; Davis, 1984; Kennedy & Tipps, 1991; Reese & Overton, 1970). The learning of mathematics does not begin on the first day of school (Kennedy & Tipps, 1991; National Council of Teachers of Mathematics, 1982, 1988; Piaget, 1952; Post, 1992). Development of mathematical concepts such as number, measurement, functions, and geometry begins at home through the child's interaction with his parents (Ford & Crew, 1991). Informal mathematical experiences also occur incidental to children's play, daycare, preschool, and kindergarten (Kennedy & Tipps, 1991).

Based on related research (Fennema, Peterson, Carpenter, & Lubinski, 1990; Gaines & Davis, 1990; Mulholland & Berliner, 1992; Patriaca & Kragt, 1986), it is

suggested by this researcher that parents, caregivers, preschool and kindergarten teachers will be more aware of first grade teachers' expectations of incoming first graders' mathematics skills as a result of this survey. It is further suggested that an awareness of these expectations might allow for a more successful transition to the mathematics of the primary grades. While not evaluating the merits of teacher expectations, this presentation might allow those involved with earlier mathematics learning (both formal and informal) to better design experiences and activities which will foster the acquisition of the mathematical skills expected. This presentation also may allow those involved in developing curriculum guides or "frameworks" to better assess the current state of elementary school mathematics (see California Department of Education, 1985; Florida State Department of Education, 1982; Michigan State Department of Education, 1979; Texas Education Agency, 1989).

Design

Sixty-four first grade teachers were asked to voluntarily complete a Mathematics Skills Expectations Survey (MSES) at the end of a school year and at the beginning of the next school year. The MSES is a paper and pencil survey which takes approximately fifteen minutes to complete. The MSES considers eleven basic areas of mathematics as given in Figure 1.

Insert Figure 1 about here.

The pilot administration of this survey suggested the survey is easy to complete and allows the teacher to reflect on the mathematics they are planning to teach to their students during the first year of formal mathematics instruction. The pilot also suggested that these eleven areas of mathematics are representative of those commonly expected by first grade teachers.

In addition, the MSES was composed in consultation with the Illinois State Board of Education, a review of several statewide curriculum standards, and primary teachers in California, Montana and Wyoming. It was composed with a sensitivity to the varied ethnic and linguistic backgrounds represented among incoming first grade classes.

The survey allows respondents to indicate agreement or disagreement with statements about a range of mathematical skills which they might feel incoming first graders should possess. Respondents were informed that their responses were neither right nor wrong, but were to be used to inform parents, caregivers, and educators which mathematics skills are expected by first grade. The duration of the study was approximately five months (May through October).

Procedures

All respondents received a copy of the MSES survey form. Written directions were attached to each survey. Directions read as follows:

"The purpose of this survey is to get a better understanding of what your expectations are for your incoming first grade students.

What follows is a series of mathematical skills grouped by mathematics topic. If you feel that one of your incoming students should have mastered that skill by the time the student enters your class, circle 'Yes;' if not, circle 'No.'

It is hoped that those involved with your students' education previous to your students' arrival in your classroom can do a better job of developing these mathematical skills by knowing your expectations."

Most respondents completed the survey within fifteen minutes. The survey was completed at a site of the respondent's choosing, usually a quiet place at school or at home to allow for adequate reflection. Each survey was completed by the respondent alone, not as a collaborative effort.

This researcher received the cooperation of the administrators or their agents in providing names and addresses of current or prospective first grade teachers. This allowed for the distribution of the survey to the widest range of such teachers in a nondisruptive manner.

Limitations

As with any research of this kind it was assumed that respondents were able respond to the items and would respond truthfully to the items. Successful administration of the MSES was already been carried out in a pilot study without any major limitations. Results of the pilot and this administration suggest that the mathematical skills described were understood by the respondents and honestly evaluated by the repondents.

Furthermore, it appears that the mathematical skills listed on the MSES are representative of the kinds of skills which first grade teachers expect of their incoming students. It should be noted, however, that the mathematical skills listed on the MSES are not intended to be exhaustive of such skills.

Summary of Results

Quantitative Data

A summary of the results of the first and second administration of the MSES is given in Appendix A. The first number listed in each pair is the percent of respondents selecting the given choice during the first administration of the MSES; the second number listed in each pair is the percent of respondents selecting the given choice during the second administration of the MSES. What follows is a brief analysis of each section of the MSES.

Data are analyzed with respect to mathematics Skills Clusters (Numeration, Arithmetic Computation, Measurement, Symbols, Geometry) and Performance Vectors (Written

Expectations, Oral Expectations, Calculation Expectations, Psychomotor Expectations, Visual Expectations).

Skills Cluster 1: Numeration

Numeration forms the basis for many of the mathematical skills which follow (e. g., addition, subtraction, multiplication, division). The following observations are suggested by the reduced data in this category:

1. There continued to be higher expectations for passive skills than for active skills.

2. There were increasingly higher expectations for oral performance than for written performance.

3. There continued to be higher expectations for concrete skills than for abstract skills.

4. There continued to be higher expectations for psychomotor performance than for the other performance categories.

5. There were increasingly higher expectations for student performance in the Numeration Skills Cluster between the first and second administration of the MSES. This is contrary to expected results.

Discussion of Results in Skill Cluster 1. Respondents were more likely to expect students to be able to demonstrate a skill that was visually or verbally prompted than to demonstrate a skill from memory alone; that is, there were higher expectations for passive skills than for active skills in this cluster. For example, many more teachers expected students to be able to identify (90%),

write (70%), or count (95%) the numerals 0 through 10 given the set of numerals than simple to write them from memory.

Respondents also were more likely to expect students to demonstrate oral numeration skills than written skills. One hundred percent of teachers expected incoming first graders to be able to orally count from 0 to 10, while only 70% expected students to be able to write the numerals 0 to 10.

Consistent with the work of Piaget (1952) and Gagne (1985), teachers had higher expectations for student concrete skills than for abstract skill, and for psychomotor skills than for other performance categories. Again, 100% of teachers felt that given a set of objects, students should be able to count them one by one.

Skill Cluster 2: Arithmetic Computation (Addition, Subtraction, Multiplication, Division, Fractions)

Arithmetic Computation included the four basic arithmetic operations and a direct application of division, Fractions. The following observations are suggested by the reduced data in this category:

1. There continued to be higher expectations for student performance skills in addition than in other computational abilities.

2. In all operations, there are higher expectations for concrete skills than for abstract skills.

3. There were diminishing expectations for student performance in the Arithmetic Computation Skills Cluster between the first and second administration of the MSES.

This is consistent with expected results.

Discussion of Results in Skill Cluster 2. Almost half (45%) of the teachers had performance expectations for students in addition, well above the expectations in other arithmetic computation skills (subtraction, 0-20%; multiplication, 15%; fractions, 20%). This result is consistent with the literature in developmental psychology and a cognitive science view of the teaching and learning of mathematics (see Kennedy & Tipps, 1991).

As in Skill Cluster 1, teachers were more likely to expect students to demonstrate mastery of concrete skills than for active skills. If given two sets of objects, teachers had higher expectation for student ability to add (45%), subtract (20%), multiply (15%), or use the concept of fraction (20%), than if not given a set of objects. This result also is consistent with the literature in developmental psychology.

Skill Cluster 3: Measurement (Measurement, Money, Time, Calendar)

Measurement included linear measurement (length), monetary measurement (money), and temporal measurement (time). The following observations are suggested by the reduced data in this category:

1. There continued to be higher expectations for passive skills than for active skills, except for linear measurement.

2. There continued to be higher expectations for

concrete skill than for abstract skills.

3. There tended to be higher expectations for student skills with smaller units of measurement than with larger units of measurement. Exceptions were for the units of "Dollar" and "Hour."

4. The lowest expectations for any skills assessed on the MSES were for skills associated with Time.

5. Between the first and second administration of the MSES, there were diminishing expectations for student performance in linear and monetary measurement. There were increasing or stable expectations for student performance in temporal measurement within the Measurement Skills Cluster. The former result was consistent to expected results, while the latter result was unexpected.

Discussion of the Results of Skills Cluster 3. There again were higher expectations for student passive skills than active skills. For example, a higher percent of teachers expected students to be able to identify coins (up to 90%), than to give the value (up to 20%).

As with Skills Clusters 2 and 3, teachers had higher expectations for concrete than abstract skills. These higher expectations were demonstrated with the relatively higher expectations for student ability in measurement in non-standard units (50%), the ability to identify coins (up to 90%), and Calendar skills, than to work with more abstract concepts among the Time skills.

Skill Cluster 4: Symbols

Symbols included +, -, and = . The following observations are suggested by the reduced data in this category:

1. Expectations continued to be the same for all of the symbols assessed.

2. Symbol Skills Cluster expectations were the only expectations to remain generally stable between the first and second administration of the MSES.

Discussion of the Results of Skills Cluster 4. Expectations from teachers for their students ability to work with Symbol Skills were mixed but stable between administrations of the MSES. Some respondents expected student to have mastered all of the subskills (liberal respondents) while others did not expect students to have mastered any of the subskills (conservative respondents). Whatever teacher expectations were at the first administration, neither time nor intervening student performance altered these expectations. These results suggested further investigation of teacher expectations is needed in this Skills Cluster.

Skills Cluster 5: Geometry

Geometry skills expectations surveyed involved identification or production of geometric figures. The following observations are suggested by the reduced data in this category:

1. There continued to be higher expectations for passive skills than for active skills.

2. Expectations for ability to work with geometric figures continued to be ranked as follows, from highest to lowest: (circle, square, triangle, rectangle).

3. The highest expectations for any skills assessed on the MSES continued to be for skills associated with geometry.

4. There were increasing expectations for student performance in the Geometry Skills Cluster between the first and second administration of the MSES. This is inconsistent with expected results. In fact, the greatest increase in teacher expectations for student performance between administrations of the MSES was in Geometry. (This was especially true with respect to student ability to work with a triangle.)

Discussion of the Results of Skills Cluster 5. There again were higher expectations for student passive skills than active skills. A higher percent of teachers expected students to be able to identify geometric figures (80 to 100%), than to draw the figures (55 to 90%).

The order of expectations for ability to work with geometric figures (circle, square, triangle, rectangle) may be consistent with the literature in developmental psychology and cognitive science; that is, everyday experiences in the students' world may allow them to develop earlier mastery with some figures than for others.

It should not be surprising that expectations in Skills Cluster 5 were the highest among any of the Skills Clusters.

Since geometry is the most concrete and, perhaps, the most frequently experienced set of MSES skills in children's world, it is reasonable for teachers to suggest higher expectations in the geometry cluster. The literature in child development and mathematics education supports this suggestion, especially the work of van Heile (see Crowley, 1987) and Davis (1984).

Summary of the Discussion of Results

The above discussion of results is presented graphically in Figure 2, the MSES Skills Cluster Analysis, and in Figure 3, the MSES Performance Vectors Analysis.

Insert Figures 2 and 3 about here.

As shown in Figure 2, teachers had the highest expectations within the MSES Skills Clusters for Numeration and Geometry skills. Expectations for both of these Skill Clusters increased over the period of the study. Teachers had the lowest expectations for Arithmetic Computation and Symbol skills, with expectations increasing slightly for the former and stable for the latter over the period of the study. Expectations for the Measurement Skills Cluster remained stable.

As shown in Figure 3, teachers had the highest expectations within the MSES Performance Vectors for Psychomotor Skills and the lowest expectations for

Calculation Skills. Expectations for all Performance Vectors remained stable over the period of the study.

As noted above, these results are consistent with the literature in developmental psychology, cognitive science, and mathematics education.

Qualitative Data

In addition to the above quantitative data generated by the administrations of the MSES, several unsolicited anecdotal comments were offered by respondents on the MSES form. Sample comments are presented to further illuminate the responses to the survey:

Global Comments

"Although I may expect a skill to be mastered, these skills are always reviewed."

"Many of these skills could not be mastered because of the developmental level of children of this age."

Specific Comments

" ... fine motor is still undeveloped and circles are hard to draw ... " (Geometry, circle)

" ... not usually (able to draw) with all side equal ... " (Geometry, square)

" ... easier (because) sides don't have to be the same ... " (Geometry, rectangle)

Recommendations and Implications

It is anticipated that recommendations and implications of this survey could have broad applicability to the planning of informal mathematics experiences and activities

which precede the formal mathematics instruction which begins in first grade. To better articulate children's mathematical experiences and activities which precede first grade with the expectations of their first grade teachers, the following are suggested:

1. Early mathematical experiences and activities should focus more on developing passive skills than on active skills.

2. Early mathematical experiences and activities should have a stronger concern for working with the concrete rather than the abstract.

3. Early mathematical experiences and activities should be more concerned with oral abilities than with written abilities.

4. Early mathematical experiences and activities should have a concern for developing psychomotor abilities.

5. Early mathematical experiences and activities need not demonstrate a strong concern for developing computational abilities.

6. Early mathematical experiences and activities should relate concepts to concrete objects from students' everyday experience.

7. This presentation may allow those involved in developing curriculum guides or "frameworks" to better assess the current state of elementary school mathematics from the perspective of practicing classroom teachers.

8. This administration and analysis of the MSES may suggest the appropriateness of other such surveys of teachers at other "educational transition points" throughout a student's education. The next "educational transition point" which researchers or educators may wish to investigate is that transition point between sixth grade (elementary school) and seventh grade (junior high school/middle school). Other educational transition points might be eighth grade (junior high school/middle school) and ninth grade (high school) and twelfth grade (high school) and college or university. An awareness of teacher expectations for incoming students at each of these levels may allow for a more successful transition to that subsequent level of mathematics education.

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Figure 1. Areas of Mathematics Considered on the MSES

1. Numeration
2. Addition
3. Subtraction
4. Multiplication
5. Fractions
6. Measurement
7. Money
8. Time
9. Calendar
10. Symbols
11. Geometry

Figure 2. MSES Skills Cluster Analysis

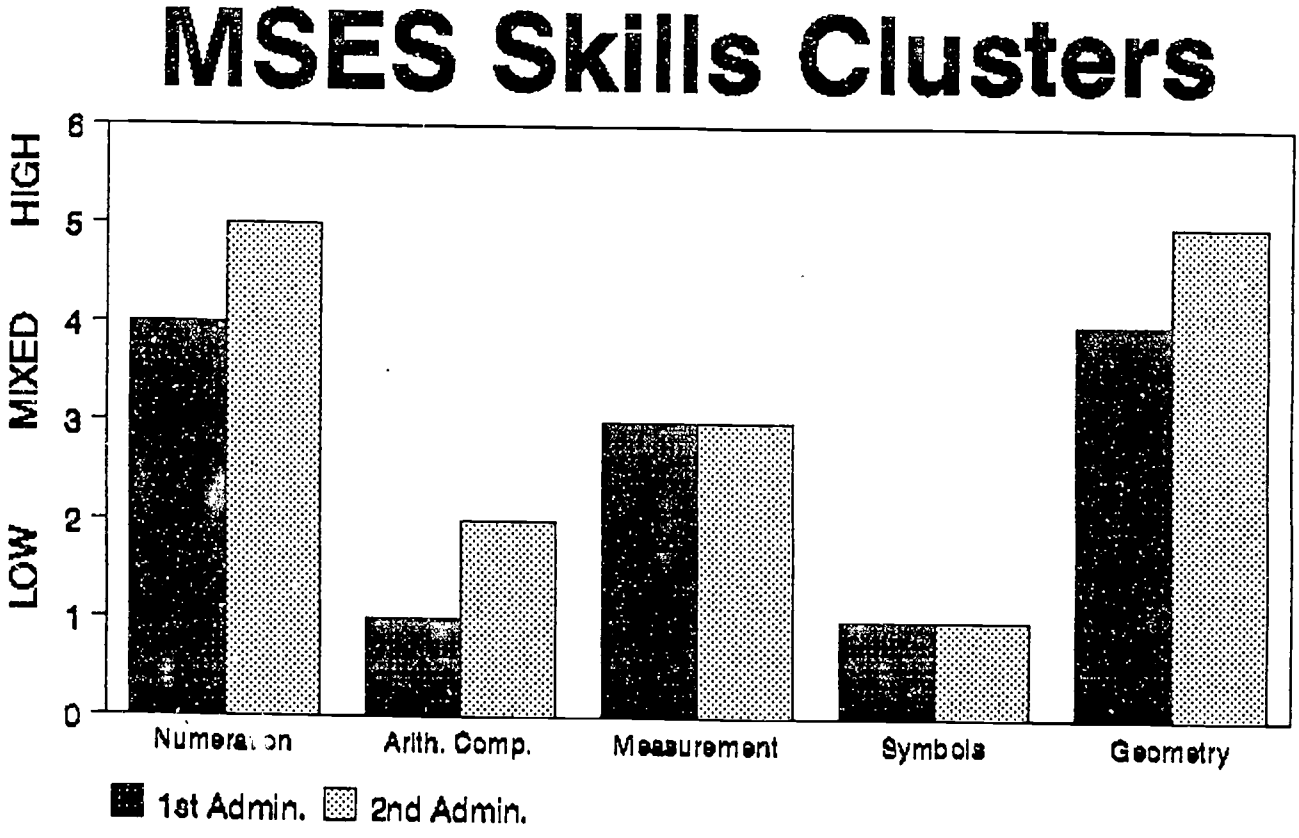
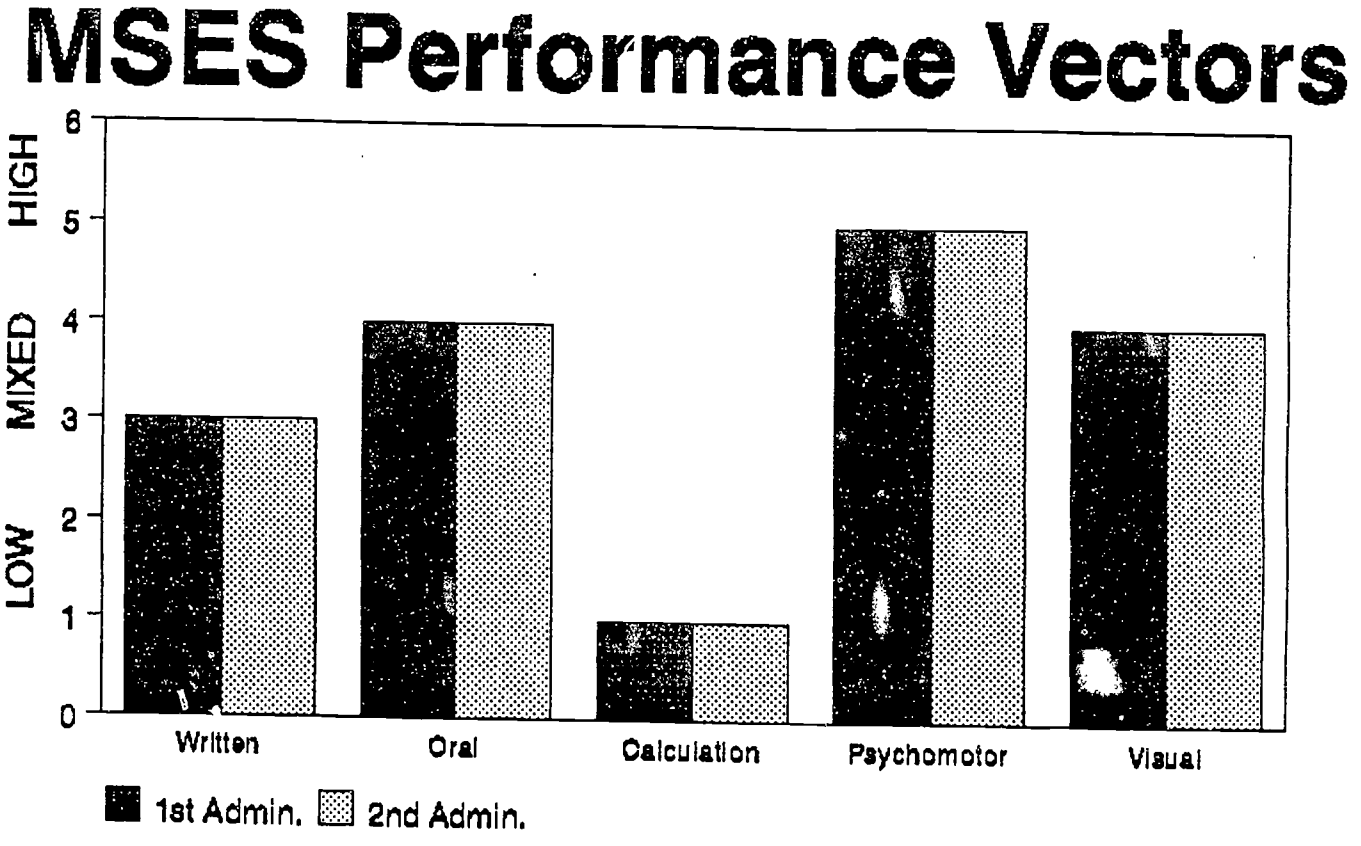


Figure 3. MSES Performance Vectors Analysis



Appendix A

RESULTS OF MSES

Numeration

Given a set of the numerals 0 through 10, a child should be able to identify them.

Yes	No
77/90	23/10

Given a set of the numerals 0 through 10, a child should be able to count them.

Yes	No
90/95	10/5

Given a set of the numerals 0 through 10, a child should be able to write them.

Yes	No
60/70	40/30

A child should be able to write the numerals 0 through 10 from memory.

Yes	No
48/50	52/50

Given a set of 0 to 10 objects, a child should be able to count them one by one.

Yes	No
100/100	0/0

A child should be able to count to 10 by 2's.

Yes	No
0/10	100/90

Addition

Given two sets of objects, each not containing more than 9

objects, a child should be able to find their sum.

Yes	No
52/45	48/55

Given two, one-digit numbers, a child should be able to find their sum.

Yes	No
5/5	95/95

Subtraction

Given two sets of objects, each not containing more than 9 objects, a child should be able to find the difference between the smaller and the larger.

Yes	No
35/20	65/80

Given two, one-digit numbers, a child should be able to find the difference between the smaller and the larger.

Yes	No
0/0	100/100

Multiplication

Given two equal sets of objects to 5, a child should be able to compute the product to 10.
(For example, two 3's is 6.)

Yes	No
20/15	80/85

Fractions

Given a group of objects, a child should be able to identify half of the group.

Yes	No
35/20	65/80

Measurement

A child should be able to measure an object in non-standard units.

Yes	No
60/50	40/50

A child should be able to recognize the relative length of an inch, foot, and yard.

Yes	No
0/10	100/90

A child should be able to recognize the relative length of a millimeter, centimeter, and meter.

Yes	No
0/5	100/95

Money

A child should be able to identify each of the following:

	Yes	No
Penny	85/90	15/10
Nickel	48/40	52/60
Dime	43/40	57/60
Quarter	20/15	80/85
Half dollar	5/0	95/100
Dollar	50/50	50/50

A child should be able to give the value of each of the following in pennies:

Nickel	Yes 25/20	No 75/80
Dime	Yes 25/15	No 75/85
Quarter	Yes 5/0	No 95/100
Half dollar	Yes 0/0	No 100/100
Dollar	Yes 0/0	No 100/100

Time

Given a non-digital clock, a child should be able to identify the:

Hour hand	Yes 10/15	No 90/85
Minute hand	Yes 10/15	No 90/85
Second hand	Yes 5/0	No 95/100

Given the time on a non-digital clock, a child should be able to tell time on the hour.

Yes	No
15/0	85/100

Given the time on a non-digital clock, a child should be able to tell time on the half hour.

Yes	No
0/0	100/100

Calendar

Given a calendar, a child should be able to identify it by name.

Yes	No
80/90	20/10

A child should be able to name the months of the year in order from memory alone.

Yes	No
15/10	85/90

A child should be able to name the days of the week in order from memory alone.

Yes	No
50/45	50/55

Symbols

Given a number sentence, a child should be able to identify the symbol for addition.

Yes	No
25/30	75/70

Given a number sentence, a child should be able to identify the symbol for subtraction.

Yes	No
25/25	75/75

Given a number sentence, a child should be able to identify the symbol for equality.

Yes	No
25/30	75/70

Geometry

Given a circle, a child should be able to identify it.

Yes	No
100/100	0/0

Given the name of a circle, a child should be able to draw it.

Yes	No
85/90	15/10

Given a square, a child should be able to identify it.

Yes	No
100/100	0/0

Given the name of a square, a child should be able to draw it.

Yes	No
80/85	20/15

Given a rectangle, a child should be able to identify it.

Yes	No
62/80	38/20

Given the name of a rectangle, a child should be able to draw it.

Yes	No
50/55	50/45

Given a triangle, a child should be able to identify it.

Yes	No
75/95	25/5

Given the name of a triangle, a child should be able to draw it.

Yes	No
57/70	43/30