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ABSTRACT

Presented is a detailed discussion of the performance pattern of third- and sixth-grade pupils in the Los Angeles Unified School District (LAUSD) for the skill area of fractional numbers. The report begins with a brief and general introduction regarding minimum competencies and continues with tables showing the performance levels of non-English speaking/limited English speaking (NES/LES) and English/Bilingual students. The results discussed are those of a feasibility study conducted in fall 1978, which involved 3,835 students. Among the findings, the data revealed that all students in third grade have difficulty in differentiating between the concept of fraction and the concept of ratio when in a parts to whole context. It was also found that students at the sixth-grade level have difficulty adding and subtracting fractions or multiplying a whole or mixed number by a fraction. Performance patterns are identified for both groups in fractional number skills and suggestions for improving instruction are advanced. (MP)

SWRL

DATE: April 24, 1979

TO: Drs. Aaron Buchanan and Patricia Milazzo

FROM: Luis Ortiz-Franco LOF

SUBJECT: MATHEMATICAL SKILLS AND PERFORMANCE OF THE ELEMENTARY SCHOOL STUDENT IN LAUSD: FRACTIONAL NUMBERS

COPIES TO:

The paper attached offers a detailed discussion of the performance pattern of LAUSD elementary school students in the skill area of fractional numbers. The text begins with a brief and general introduction regarding minimum competencies and continues with tables showing the performance levels of NES/LES and English/Bilingual students. The essay discusses some suggestions for improving instruction in the skill area analyzed and ends with a brief summary. The results discussed are those of the feasibility study conducted in fall 1978.

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Attachment

MATHEMATICAL SKILLS AND PERFORMANCE OF THE ELEMENTARY SCHOOL STUDENT IN LAUSD: FRACTIONAL NUMBERS

by

Luis Ortiz-Franco

This paper discusses the performance of English/Bilingual and NES/LES third and sixth grade students in LAUSD. Performance patterns are identified for both groups in fractional number skills and suggestions for improving instruction are advanced.

MATHEMATICAL SKILLS AND PERFORMANCE OF THE ELEMENTARY SCHOOL STUDENT IN LAUSD: FRACTIONAL NUMBERS

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Introduction

The concern over the level of competency in basic skills of high school graduates in the U.S. has motivated states to adopt standards of proficiency for high school graduation. Over three-fourths of the states in the nation are in the process of establishing tests of minimum competency; usually to be used prior to high school graduation. The development of the minimum competency tests is sometimes the responsibility of the state department of education and in other instances local school districts are charged with this task.

In California, Assembly Bill 3408, as amended by AB65, calls for any high school district to adopt local standards of proficiency in basic skills by June, 1978. After June, 1980, no student who has not met these standards can receive a high school diploma. The progress of individual students toward these proficiency standards must be assessed by the districts at three prescribed intervals prior to the twelfth grade: once in the 4th through 6th grade experience, once during the 7th through 9th grade experience, and twice during the 10th through 11th grade experience. The law does not preclude any district from conducting an assessment of any pupil in English and in the native language of such pupil. Although the native language of limited English speaking (LES) and non-English speaking (NES) students may be used for enroute assessment, the NES/LES students will have to pass the final assessment of their proficiency in basic skills in the English language. Nor does the law preclude local districts from assessing progress in fundamental skills at the end of each grade level and to use such assessment as criterion for promotion to the next higher grade.

The Los Angeles Unified School District (LAUSD) is one district which is developing a grade-by-grade assessment program in conjunction with the state mandated proficiency in basic skills assessment. LAUSD's grade-by-grade assessment program poses several issues pertaining to the educational progress of the NES/LES students. One issue deals with the language of the assessment instruments, English or non-English, and another issue is related to the uses of the assessment instruments. A third issue linked to these two is the language of instruction.

There are at least two alternatives uses of the grade-by-grade assessment instruments by LAUSD. One alternative is to use the assessment instruments as achievement indicators and the other is to use them as diagnostic instruments. The second alternative seems to be implicit in the LAUSD grade-by-grade assessment policy. And this perspective immediately brings up the question of the language of assessment of the NES/LES students. It is widely accepted by now that the proper way to best diagnose the academic needs of NES/LES students is by using the native language of the students. This is true also for the monolingual English speaking students. The academic needs of fluent bilingual students, English and another language, can be diagnosed in either language provided the students have received instruction in both languages. Otherwise, the academic needs of fluent bilingual students should be assessed in the language which has been their medium of instruction.

Thus, English monolingual students as well as the fluent bilinguals can be assessed in English but the NES/LES students ought to be assessed in their native language. Concomitantly, the language of instruction should be congruent to the language of assessment in order to maximize the accuracy in diagnosing academic skills.

The purpose of this paper is to discuss the performance of 3rd and 6th grade NES/LES and English/Bilingual students in LAUSD on the preliminary version of a mathematics assessment instrument and to offer suggestions for instruction to improve the performance levels of these elementary school students. In this report, attention is focused on the skill areas of fractional numbers.

METHOD

Subjects

A total of 3,835 students from schools in the Los Angeles Unified School District participated in the study. One thousand seven hundred and forty were representative of the third grade population and 2,095 were representative of sixth grade students. Three hundred eighty four of the 1,740 third grade sample were classified as NES/LES and 1,356 were classified as English/Bilingual. In the sixth grade representative sample, 795 were classified as NES/LES and 1,300 were classified as English/Bilingual. For the purposes of this study, students classified as other with respect to language were included in the NES/LES sample.

Instruments

The preliminary version of the Assessment of Progress in Mathematics Skills: Mathematics A was administered to the third grade representative population and Assessment of Progress in Mathematics Skills: Mathematics B, preliminary version, was administered to the sixth grade representative population. Both versions contained 87 problems each distributed over eight skill areas for grade three and nine skill areas for grade six. The skill area covered in grade six but not in grade three was percent.

Procedure

The study was conducted during fall '78 and about 60 schools of LAUSD participated, 30 at each grade level. Approximately three classrooms from each school took part in the study. The intentions of the study were to assess those mathematics skills likely to be part of a student's repertoire at the end of the 3rd and 6th grades. Students at the beginning of the 4th and 7th grades were assumed to represent students at the end of the 3rd and 6th grade respectively. The premise behind this assumption was that the amount of forgetting that might have occurred during the summer months, between the end of the previous school year and the beginning of the present one, was compensated for by the review and practice that took place during the months of September and October 1978 prior to this study. Thus the statements in this paper about 3rd and 6th graders' mathematics skills are well grounded.

The skills, difficulty, and vocabulary levels in the assessment instruments reflect as close as possible the level of the regular practice exercises in the respective elementary curriculum materials. Consequently, the assessment items tap the kinds of performance expected of students in the regular classroom with certain modifications as needed to place items in a machine scorable, multiple-choice format.

Classroom teachers administered the tests to their respective classes and they also classified the students into NES/LES or English/Bilingual. The bilingual students were judged by their respective teachers to be fluent in English and another language, usually Spanish. The assessment instruments were administered in English to all students.

An analysis of the students' performance by grade level, language, correct answer and main distractor, and cognitive process involved in the assessment items is discussed below.

RESULTS

The percent of correct responses to each item in the selected skill areas of fractions is the statistic used in analyzing the results. This chosen statistic seems to be quite adequate in fulfilling the diagnostic purposes of the assessment instruments. In such endeavors, one is interested what portion (percentage) of the student population has or has not mastered the given skill or topic. Thus, the tables below, one for each grade, illustrate the percent of students answering the items correctly and the main distractor. Of the several wrong choices, the one picked by the greatest portion (percent) of students was designated as the main distractor. The tables provide information by language classification for each individual item.

Table 1, below illustrates the result for the 3rd grade representative sample. The skill area and item number column indicates the area under discussion, fractional numbers. The numbers underneath each skill area indicate the item number as it appeared in the assessment instrument. For instance, there were six items in the assessment instrument probing the students' skills with fractional numbers, and they were items 16-21.

Table 1. Performance Level of Representative 3rd Grade Population by Language Classification and Skill Area for Each Item: Percent Correct and Main Distractor.

Skill Area and Item Number	NES/LES		English/Bilingual	
	Correct Answer %	Main Distractor %	Correct Answer %	Main Distractor %
Fractional Numbers				
16	24*	33	27*	34
17	73	14	82	10
18	19	61	32	53
19	60	22	82	9
20	27	44	35	40
21	30	43	42	35

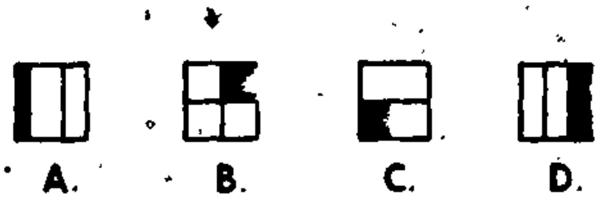
*Decimal point is omitted.

One last observation before we discuss the results. There is presently a great deal of interest and concern for the cognitive processes involved in mathematics assessment at the national level. How long it will be before this trend filters down to state and local levels is difficult to say. But as a way of a contribution in this area, three items in Table 1 are classified as belonging to the mathematical knowledge (MK) process domain and the other three belong to the mathematical understanding (MU) process domain. Briefly stated, mathematical knowledge refers to the recall and recognition of mathematical ideas expressed in words, symbols or figures. It relies for the most part on memory processes. Exercises that assess this cognitive category require that a person recall or recognize one or more items of information.

Mathematical understanding refers to the explanation and interpretation of mathematical knowledge and it relies primarily on transformation processes. Exercises that assess this cognitive category require that a person provide an explanation or an illustration for one or more items of knowledge.

Now we are ready to interpret the information in Table 1. All six items in the fractional numbers area for grade three assessed the skill of numeration: the identification of parts of a whole and identification of number of equal or fractional parts of a whole. Item 17 asked pupils to identify the one, out of four possible choices, circular region with 5 equal parts. Eighty two percent of the English/Bilingual students chose the correct answer while only 73% of the NES/LES students did so. Item 19 asked students to identify the figure divided into thirds and item 18 requested pupils to choose the figure showing one-third black. Eighty two percent of the English/Bilingual students got item 19 correct while only 60% of the NES/LES pupils succeeded in doing so. Thirty two percent of the English/Bilingual sample answered correctly item 18 but only 19% of the NES/LES sample did so. The main distractor for both samples was option B and this is indeed revealing. It is revealing due to the fact that 61% of the NES/LES students and 53% of the English/Bilinguals chose it. It seems that most students have not mastered the concept of fraction when placed in the parts of a whole context. Item 18 is illustrated below.

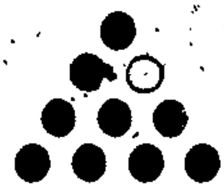
18 Which square shows 1/3 black?



The choice of distractor seems to indicate that students tend to confuse the concept of fraction with that of ratio. That is, the distractor figure shows one part black to three parts blank (1/3) and not one-third black as does the correct option D. This observation appears to be strongly supported by the students' performance on items 16, 20 and 21.

On item 16, illustrated below, students were asked "Which fraction tells how much of the set is black?" The set consisted of ten (10) circles out of which nine (9) were black and one (1) was blank. The correct answer to the question is 9/10 but a greater portion of students chose the option showing the numerical value 9/1 than those choosing the correct answer. More specifically, 24% of the NES/LES students picked 9/10 but 33% selected 9/1. Among the English/Bilingual students, 27% chose 9/10 and 34% picked 9/1. The main distractor would have been the correct answer if the question had asked the ratio of black circle to white circles (9/1). This pattern was repeated in the answers to items 20 and 21 which asked similar questions.

16



Which fraction tells how much of the set is black?

$\frac{9}{10}$ $\frac{9}{1}$ $\frac{1}{9}$ $\frac{10}{9}$

A. **B.** **C.** **D.**

Item 20 depicted a circle divided into eight parts out of which three were shaded and five were not. The question asked students to tell the fractional part shaded. Twenty-seven percent of the NES/LES pupils answered correctly (3/8) but 44% answered 3/5. Forty percent of the English/Bilingual students those 3/5 and only 35% provided the correct answer. Again, the main distractor would have been the correct answer had the question been the proportion of shaded parts ~~to~~ white parts.

In item 21, 43% of the NES/LES students chose the answer illustrating the ratio of shaded parts to blank parts of a set instead of the option illustrating the fractional part of the set shaded, which was selected by only 30% of the pupils. Among the English/Bilingual students, 42% chose the right answer and 35% picked the option illustrating the ratio of shaded to white parts.

Summary

A small percentage of 3rd graders exhibited any knowledge of fractions concepts, although low results probably reflect lack of exposure to these concepts for this grade level. Only for problems 17 and 19 a 60% or higher proportion of either student populations answered correctly. About 40% or less of students in both populations were able to answer the other problems correctly.

Table 2 below, shows the performance results of the 6th grade representative population. As it can be seen, for this grade level the fractional numbers skill area is subdivided into numeration and computation. This subdivision reflects the spiralling character of the mathematics curriculum and instruction in the elementary school. More precisely, by the time students reach the 6th grade they have already been instructed in fractional numbers numeration as well as in computation.

The cognitive process domain assessed by these exercises is mathematical skill (MS). Mathematical skill is a cognitive process that refers to the routine manipulation of mathematical ideas and it relies on algorithmic processes. Exercises that assess mathematical skill assume that the required algorithm has been learned and practiced. Such exercises aim at measuring proficiency in carrying out the algorithm rather than the understanding of how or why it works.

In the specific skill area of fractional numbers numeration, items 14 and 16 asked students to reduce to lowest terms. More than 50% of the students in both samples worked problem 14 successfully. However,

Table 2. Performance Level of Representative 6th Grade Population by Language Classification and Skill Area for Each Item: Percent Correct and Main Distractor.

Skill Area and Item Number	NES/LES Correct Answer %	NES/LES Main Distractor %	English/Bilingual Correct Answer %	English/Bilingual Main Distractor %
Fractional Numbers				
Numeration				
14	55*	16	66*	13
15	48	15	58	13
16	34	32	44	20
17	46	17	59	15
Computation				
25	31	45	41	40
26	29	58	34	54
27	26	51	32	46
28	34	27	43	26
29	24	52	34	49
30	23	33	32	35
31	24	36	38	31
32	67	14	75	10
33	22	49	30	52

*Decimal point is omitted.

the performance on item 16 was not as good and if we look closer at the correct answer and at the main distractor we detect the following. The process of reducing to lowest terms was not carried to its final step. That is, 5/20, the main distractor, can be further simplified to 1/4 which is the correct answer. Only 34% of the NES/LES students and 44% of the English/Bilingual students succeeded in reducing the original fraction to lowest terms. Item 16 is illustrated below.

What is the lowest-terms fraction?
(simplify)

$\boxed{\frac{15}{60}}$ 16

$\frac{1}{4}$ $\frac{5}{20}$ $\frac{7}{30}$ $\frac{1}{3}$

A. B. C. D.

Students were requested to provide the mixed number for the improper fraction given in item 15 and to provide the improper fraction for the mixed number given in item 17. Forty eight percent of the NES/LES students did provide the correct answer for item 15 but only 46% succeeded in correctly giving the improper fraction when the mixed number was given. On the other hand, 58% of the English/Bilingual pupils provided the correct mixed number given the improper fraction and 59% succeeded in correctly giving the improper fraction given the mixed number. The improper fraction to be changed to a mixed number was 15/4 and the mixed number to be changed to an improper fraction was 2 3/5.

By looking at the main distractor, we can see that 15% of the NES/LES students subtracted the denominator from the numerator to get the whole part of the mixed number instead of dividing. Thirteen percent of the NES/LES students seemed to have made a careless mistake rather than one of performing the wrong operation. In Item 17, 15% of English/Bilinguals and 17% of the NES/LES students performed the right operation but forgot to add the numerator to the product of 2 X 5. These two items are shown below.

What is the mixed number for this fraction?

$\boxed{\frac{15}{4}}$ 15

A. $4\frac{3}{4}$ B. $3\frac{3}{5}$ C. $11\frac{1}{4}$ D. $3\frac{3}{4}$

What is the fraction for this mixed number?

$\boxed{2\frac{3}{5}}$ 17

A. $\frac{23}{5}$ B. $\frac{13}{5}$ C. $\frac{10}{5}$ D. $\frac{12}{5}$

Items 25-27 assessed students' skills in adding fractions. While item 27 involved the addition of mixed numbers, items 25 and 26 involved the addition of proper fractions. In both populations, a greater percentage of students answered the problems wrong than answering correctly.

The common procedure used was to add numerators and designating the result as the final numerator and to add denominators and designating the result as the final denominator. Fifty eight percent of the NES/LES subjects and 54% of the English/Bilinguals gave the answer 9/12 as the correct one when it should have been 1 4/9 for item 26 below. Thus, students seemed to have forgotten that when adding fractions with unlike denominators we are supposed to find a common denominator, divide the common denominator by each numerator, then multiply the quotient by the respective numerators and, finally, add the products. Or perhaps they were not exposed to this technique long enough to achieve mastery..

26

$$\frac{2}{3} + \frac{7}{9} = \underline{\qquad}$$

A.	B.	C.	D.
$\frac{9}{13}$	$\frac{9}{12}$	$1\frac{5}{10}$	$1\frac{4}{9}$

In subtracting fractions, items 28-29, many students seemed to have repeated the same procedure as in adding fractions, although not as many in the case of the English/Bilinguals. Item 28, involving the subtraction of mixed numbers, registered a lower performance level on the part of both samples than item 28, involving only proper fractions. Pupils chose the easier but incorrect procedure of computing straight subtraction rather than going through the entire process when answering problem 29. Most students choose 2 1/2 as their answer instead of the correct one, 1 1/2.

$$\begin{array}{r} 4 \\ +\ 2\frac{1}{2} \\ \hline \end{array}$$

29

$2\frac{1}{2}$ A. $2\frac{1}{4}$ B. $1\frac{1}{2}$ C. 2 D.

Items 30-33 assessed students' skills in multiplying fractions. Two items, 30 and 31 involved the multiplication of a whole number by a proper fraction, item 32 asked for the multiplication of two proper fractions, and in item 33 students were requested to multiply a mixed number by a proper fraction. The highest performance level was registered in the multiplication of two proper fractions where 67% of the NES/LES students and 75% of the English/Bilinguals answered the question correctly. The lowest performance level was in the multiplication of a mixed number by a proper fraction. In this instance, only 22% of the NES/LES subjects got the correct answer and 30% of the English/Bilinguals did so (item 33 depicted below).

$$2\frac{4}{5} \times \frac{1}{2} = \_\_\_\_$$

(Give answer in lowest terms.)

33

$2\frac{4}{10}$ A. $1\frac{7}{5}$ B. $1\frac{2}{5}$ C. $2\frac{6}{7}$ D.

In multiplying a whole number by a proper fraction, items 30 and 31, one-third of the students in both samples multiplied the whole number by the denominator and the product was placed as the final denominator leaving the initial numerator unchanged. The correct procedure being the multiplication of the whole number by the numerator and leaving the initial denominator unchanged. Thus, it seems that this portion of the student samples have yet to successfully discriminate the correct procedure. Item 30 is shown below in which 23% of the NES/LES pupils and 32% of the English/Bilingual ones answered correctly.

$\frac{2}{3} \times 9 =$ ____ 30

A.	B.	C.	D.
$\frac{2}{27}$	3	$9\frac{2}{3}$	6

<u>Summary</u>

Sixth grade students did better in fractional numbers numeration than in fractional numbers computation. The best performance was registered in the multiplication of two proper fractions. A small percentage of sixth graders exhibited any knowledge of addition and subtraction of fractional numbers. Performance on the multiplication of mixed numbers by fractions or whole numbers was also very low.

DISCUSSION

This section outlines some suggestions for instruction aimed at improving the skills of LAUSD elementary school students in the area of fractional numbers. Due to the common weaknesses of the NES/LES and English/Bilingual pupils in working with fractional numbers, the suggestions made here are meant to apply to both populations. However, given the added language factor of the NES/LES students additional suggestions for instructing this group of students are made.

The central concern of classroom instruction is or ought to be student achievement. There are many variables that directly or indirectly affect student achievement and among them we can list the student's environment in and out of the classroom, the teacher, the curriculum, and the objectives of that curriculum. The teacher and the curriculum affect the instructional process and hence what the student learns. Student learning or achievement level is usually compared to the desired achievement expressed in stated objectives. It is a commonly held belief that if teachers cover the stated curriculum objectives student achievement approximates the desired achievement level. That is, if teachers teach a given topic in the classroom students do learn that topic. However, teachers' instructional activities are strongly influenced by textbooks and if a given topic is not in the textbook chances are teachers will not cover it and, consequently, students will not learn it. On the other hand, if a mathematical topic is in the text students do learn it. There is evidence to indicate that most student learning is directed by the text rather than the teacher. And texts that are overly formal tend to be less effective than others. In short, objectives, curriculum, teachers, and instructional process affect student achievement and these are variables that are easier to manipulate the students' environment.

Now, the implications of the above statements for LAUSD elementary school students mathematics achievement in general, and fractional numbers in particular, seem to be as follows. The low achievement level of English/Bilinguals and NES/LES pupils suggest that either fractional number skills are not an overly important objective, or that the curriculum and teachers, and hence the instructional process, do not adequately emphasize this skill area. Current LAUSD elementary mathematics objectives indicate that fractional number skills are indeed important, and an examination of the currently used mathematics textbooks show an adequate coverage of fractional numbers. Consequently, the low achievement in fractional numbers of LAUSD elementary school pupils seems to be due to teachers and instructional process factors. The following paragraphs address this issue.

It is suggested that a way to facilitate the distinction between ratio and fraction among 3rd graders teachers ought to partition instruction as follows. Spend a considerable amount of instructional time in teaching students that the total number of parts of a whole constitute the denominator. Emphasize also the relationship between ordinal numbers and names of fractions, e.g., thirds, fourths, fifths, tenths, etc. Illustrate by means of examples and exercises how wholes look like when partioned into these fractional parts. And have students write the total number of parts as the denominator without asking them anything about the numerator. Make sure students master this particular skill by means of in class exercises, as a group and individually, home-work assignments, divide the class into three or so groups and organize competitions among groups, independent study, and so on. The teaching of this skill should continue until the entire class has mastered it. Once this has occurred, then teachers can gradually proceed to instruct the class in assigning numbers to the numerator based on the number of parts desired.

For example, suppose students have already developed the skill of identifying the 10 as the denominator for something divided into ten equal parts. The teacher should then proceed to illustrate that 1/10, 3/10, 7/10, etc., signifiy 1 portion out of 10, 3 portions out of 10, 7 portions out of 10, etc. This same procedure can be followed for fractions with other denominators.

When instructing students in the addition and subtraction of fractions, it may be helpful to clearly distinguish between fractions with like denominators and those with unlike denominators and the different procedures involved in adding and subtracting the two types of fractions. In doing so, it may be useful to emphasize to students that fractions with like denominators belong to one set and those with unlike denominators belong to a different set. And that the way we add or subtract is different for the two different sets. Perhaps analogies can help at this juncture. For example, when adding or subtracting fractions with like denominators is like adding or subtracting objects or things that are alike: oranges and oranges, chairs and chairs, desks and desks, etc. And that adding or subtracting fractions with unlike denominators is like trying to add or subtract objects or things that are not alike. Thus, in order to add or subtract we must change them so that they become alike. Which is exactly the purpose of finding the common denominator. Instruction here should proceed more carefully and over a long period of time than when teaching addition or subtraction with like denominators.

The results of the students' performance on item 32 indicate that upwards of 2/3 of the pupils know how to multiply two fractions; the difficulty appears to be when students are asked to multiply a whole number by a fraction or a mixed number by a fraction. The common mistake here appears to be due to not remembering that a whole number is equal to a fraction having that particular number as numerator with a one as the denominator, e.g., 5 = 5/1. Thus, it stands to reason that a way of increasing students' proficiency in multiplying a whole number by a fraction is to make sure pupils know how to convert a whole number into a fraction with a one as denominator. This can be accomplished by simple repetition and reinforcement periodically reviewed over an extended period of time. The case of multiplying a mixed number by a fraction can be dealt with as follows. Emphasize the need to convert the mixed number into a fraction and then proceed to use the technique of multiplying fractions by fractions. Again, instruction followed by repetition and reinforcement with periodic reviews can take the students a long way in developing proficiency in this skill area.

The above suggestions apply to the instruction of all students. However, some additional factors ought to be considered for the case of the NES/LES students. First, LAUSD ought to adopt the policy of making it possible for schools and classroom teachers to administer diagnostic mathematics assessments at the beginning of the school year in the language of the student(s). The diagnostic instrument can conceivably consist of two parts: one encompassing rote skills, addition, subtraction, multiplication, division, etc., and the other can include mathematical terms, concepts, and vocabulary. Such a diagnostic instrument has the potential to facilitate placement of the NES/LES students at their appropriate skill and cognitive level, and assist teachers in deciding whether these students need more instruction on mathematical skills or on vocabulary and concept development. This could result in a better learning and instruction atmosphere. This can contribute to an increased student achievement level and increased satisfaction for all concerned.

Second, the instructional process for the NES/LES students should take place in their native language when new concepts and skills are introduced and taught. English can be the medium of instruction when reviewing concepts and skills already mastered by these pupils. It is of cardinal importance to assure that teachers of NES/LES pupils speak the language of the students adequately. A person who took courses for a year or two of the language in question at the college level will more than likely not be able to impart instruction in that language to native speakers.

Third, those teachers imparting instruction in a language other than English should know the mathematics vocabulary and terminology in that language. If no such personnel exists in LAUSD this can perhaps be alleviated by in-service training, summer courses, seminars or workshops. Fourth, in order to better assess the mathematics skills of NES/LES pupils, whether at the beginning, middle, or end of the school year, the assessment instruments should be in their native language. Otherwise, the assessment of mathematics skills will be confounded with language skills assessment.

Fifth, curriculum materials in the language of the students should be made available to both students and teachers to better reinforce the instructional process. Supplementary materials, math labs, and other curriculum aids should also be accessible in the language of the students.

Finally, an effort should be made to integrate the school's curriculum and instructional process with resource, human and physical, in the outside community. This suggestion applies to both English/Bilingual and NES/LES pupils, and it aims at minimizing the discrepancy between the in school and out of school students' environment.

SUMMARY

Three thousand eight hundred thirty five students in the 3rd and 6th grade in Los Angeles took an assessment of progress in fundamental skills in mathematics during fall 1978. One thousand seven hundred forty were third graders and 2,095 were sixth graders. There 384 NES/LES pupils and 1,350 English/Bilingual in the third grade sample while 795 were NES/LES and 1,300 English/Bilinguals in the sixth grade. Third

grade students in LAUSD are still unable to distinguish the concept of fraction from that of ratio. Sixth grade students have difficulty in adding and subtracting fractions, multiplying a whole number by a fraction, and in multiplying a mixed number by a fraction. At both grade levels, NES/LES students performed less well than English/Bilingual pupils.

It was found that all students in the third grade have difficulty in differentiating between the concept of fraction and the concept of ratio when in a parts to whole context. Students at the sixth grade level performed low in the addition and subtraction of fractions. In multiplying fractions, students performed better when multiplying two fractions than when multiplying a whole number by a fraction.

The discussion section outlined some suggestions for instruction to improve the mathematics achievement of elementary school pupils in fractional numbers.