PATTERNS OF STUDENT PERFORMANCE ON MATHEMATICS ASSESSMENTS ALIGNED WITH BAHRAIN MINISTRY OF EDUCATION CURRICULUM DIRECTIVES AND MATERIALS, BY GRADE LEVEL, GENDER AND CLASSROOM ORGANIZATIONAL STRUCTURE

by

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DISSERTATION ABSTRACT

Purpose. The purpose of this study was twofold: (1) construct a psychometrically adequate mathematics achievement test sufficiently sensitive to identify instructional problems associated with misalignments between curriculum guidelines, published textbooks and classroom practice in the elementary schools of Bahrain; (2) analyze student performance on the test in an attempt to identify differential performance profiles associated with gender, variations in classroom organization and/or misalignments between stated objectives, textbook coverage and instructional syllabi.

Methodology. State-mandated curriculum guidelines, adopted textbooks and teacher syllabi were analyzed as a basis for preliminary identification of skills misalignments. The guidelines and textbooks were used as a source for item sampling and test construction. Four interlocking forms were constructed conforming the progression of skills in grades one through four. The sample included 3,316 students in the designated grades from 24 different schools. Standard psychometric procedures were used to refine the instrument prior to its use in addressing the second purpose of the study. Comparisons among variations in gender and classroom organization were made using both single and multiple

ANOVA.

Findings. Similar to studies in the United States, student performance was higher in the first two grades than in the latter two, suggesting the effects of both increased skills complexity and cumulative effect of non-mastery at the lower levels. Females tended to outperfrom males and, children in the self-contained classrooms scored higher than those in the departmentalized classrooms. When instructional misalignments between objectives and text coverage were considered, there was a strong suggestion that the self-contained classroom organizational structure was the most supportive. Further, it appeared that male at the early grades found the self-contained classroom more supportive.

Conclusions. The curriculum alignment embodied in this study has important implications for the improvement of instructional effectiveness across all curriculum areas in Bahrain. An assessment that is systematically correlated with curriculum guidelines, instructional objectives and classroom transactions will provide an instructional information system to: (a) help ensure continuity of student performance across grade levels and (b) determine beneficial organizational and psychological support mechanisms.

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CHAPTER I

INTRODUCTION

The process of elementary mathematics instruction in Bahrain, as in the United States, is influenced by a number of factors. Student acquisition of mathematics knowledge and competence is associated with such matters as student level of ability and previous opportunities to learn, instructional practices, resources available, characteristics of the staff, coordination of instruction, and assessment and evaluation. With respect to these factors, there are similarities between Bahrain and the United States. However, there are significant differences between these two educational systems. For one, educational policy in Bahrain is centralized in the Ministry of Education for the entire country. There are no local school districts governed by their own boards. Secondly, in Bahrain the curriculum for all schools is specified in detail by the Ministry of Education and is published in a written document. Syllabi consistent with the curriculum are prepared and published by the Ministry of Education. Thirdly, textbooks that support the syllabi are also published and distributed by the Ministry of Education. Every

elementary school uses the nationally adopted textbooks. Clearly, these practices are in sharp contrast to those in the United States, where local school boards, principals and even individual teachers have considerable flexibility and choice about both curriculum issues and textbooks choices.

Educational assessment and evaluation practices in Bahrain also differ markedly from practices in the United States. In Bahrain, evaluation at grades 1 and 2 relies exclusively on on-going teacher observation and clinical assessment of student progress. These assessments may or may not include teacher-made tests, depending solely upon teacher perferences. At levels above grade 2, there is a mid-year and an end-of-year test in each subject. These tests are prepared using a three-step process involving teachers and the Ministry. First, the teachers in each school prepare and submit to the Ministry of Education a draft of a mid-year and end-of-year test in each subject for each grade. The test may be multiple choice or essay items (There is no standard format or procedure to follow). Second, curriculum specialists in the Ministry of Education revise and edit the teacher-made tests (Again there is no standard format or procedure to follow). Third, the edited tests are sent to another Directorate of the

Ministry (Directorate of Evaluation and Examination) for printing and preparation of the schedule for administration of the tests by the classroom teachers. Thus, while the curriculum, syllabi and textbooks are common across all schools, the assessment instruments are idiosyncratic to each individual school.

In addition to mid-year and end-of-year tests, a formal standardized test, prepared by the Ministry of Education, is administered at the end of each "cycle" of schooling (grade 3, 6, 9 and 12). Performance on this national test determines whether the student is promoted into the next cycle of schooling.

From a psychometric point of view, the "cycle" tests have the following less-than-adequate features: (a) They lack a conceptualization framework: this means, they portray neither student performance problems nor a relevant domain of content to be learned as the result of instruction; (b) There are no specification of instructional objectives covered; (c) The development of the items are not constructed to represent specified instructional intent; and (d) In preparation for the final construction of the tests there is no technical review of the items before they are administered.

Historically, testing procedures in Bahrain have evolved without benefit of empirical validation of their

utility for evaluating schooling effectiveness. Research and development in the United States (Baker, 1974; Baker & Schutz, 1971; Bookman & Iwanicki, 1983; Cooley & Leinhardt, 1980; Hanson & Bailey, 1983; Leinhardt & Seewald, 1981; Madaus et al., 1979; Milazzo & Buchanan, 1982; Scott, 1983) has shown that the improvement of schooling is dependent upon an instructional information system that is sensitive to the effects of instruction. Clearly this general conclusion is equally applicable to Bahrain. It seems even more important when one considers the fact that the educational system in Bahrain is a centralized, Ministry-mandated, system. Under these conditions, it is critical that the tests be clearly aligned with objectives, materials and mandated classroom transactions.

Technical Framework of an Alignment Model

In terms of contemporary psychometric practice and assessment theory, several observations should be made: First, without proper alignment of objectives, instructional materials, and assessment procedures, school improvement will remain largely ineffective and a function of "clinical" judgments by the teacher (Bock et al., 1982; Freeman et al., 1983; Linn, 1983; Schmidt,

1983). Scott (1983) has pointed out that a curriculum is composed of objectives, instruction and assessment. When all three align, then the effects of schooling are at least understandable and often impressive. When these three elements are not aligned, any potential value of standardizing curriculum and instruction will be lost because the effects of schooling will be difficult to determine and therefore difficult to improve. Thus the purpose of curriculum alignment procedure is to align instruction and assessment with objectives to: (a) ensure that instruction is adequately focused on essential skills, (b) identify gaps in instruction for achieving curriculum objectives and (c) accurately profile student achievement and instruction program effectiveness.

Researchers in the United States have identified some critical problems related to basic skills instruction in elementary schools mathematics. First, it was noted that teachers had little guidance about what they were to teach the students at each grade level. As a result, students in different classrooms were likely to learn significantly different sets of skills (Bachelor & Buchanan, 1983; Milazzo & Buchanan, 1982). Second many students appeared to be working on instructional materials well below grade (Buchanan, et

al., 1983, Buchanan, 1984). Third, many teachers at the end of the year still had not "covered a significant portion of the textbooks" (Buchanan, 1982; Denmark & Kepnar, 1980; Kuhs & Freeman, 1979; Schmidt, 1983). Finally, and as would anticipated, both students and teachers were being evaluated on the basis of standardized tests which measured some but not all of what was being taught as well as what was not being taught at all (Araisian & Madaus, 1983; Bookman & Iwanicki, 1983; Buchanan, 1982 Feldhusen et al., 1976; Floden et al., 1978; Haertal & Calfee, 1983; Leinhardt & Seewald, 1981).

Second, a comprehensive instructional information system that is sufficiently sensitive to the effects of instruction is necessary to illuminate the status of present instructional accomplishments and to guide the future improvement of schooling. Baker and Hanson (1981) have defined the elements of such a system. The assessment model portrayed in Figure 1, (Adapted from Baker & Hanson, 1981) shows the several major types of assessment and indicates the general level of influences classroom instruction has on each. Clearly, the schematic provides guidance as to what kinds of assessment should be used to address the various educational issues involved. For example, while

standardized tests provide useful information over a larger period of instructional term, only tests aligned with instruction that is taking place, the materials that are being used and objectives that have been specified, will provide information useful to the instructional leaders in the school.

Because of the centralized education structure in Bahrain, the counterparts of National and State assessment, standardized tests, and ability tests necessary for a comprehensive instructional information system in the United States can be simplified in Bahrain. As shown in Figure 1, the yet-be-developed tests comprising the Bahrain Survey of Essential Skills (BSES) and the Bahrain Assessment Program (BAP) can accomplish for Bahrain the functions fulfilled by the several tests in the United States.

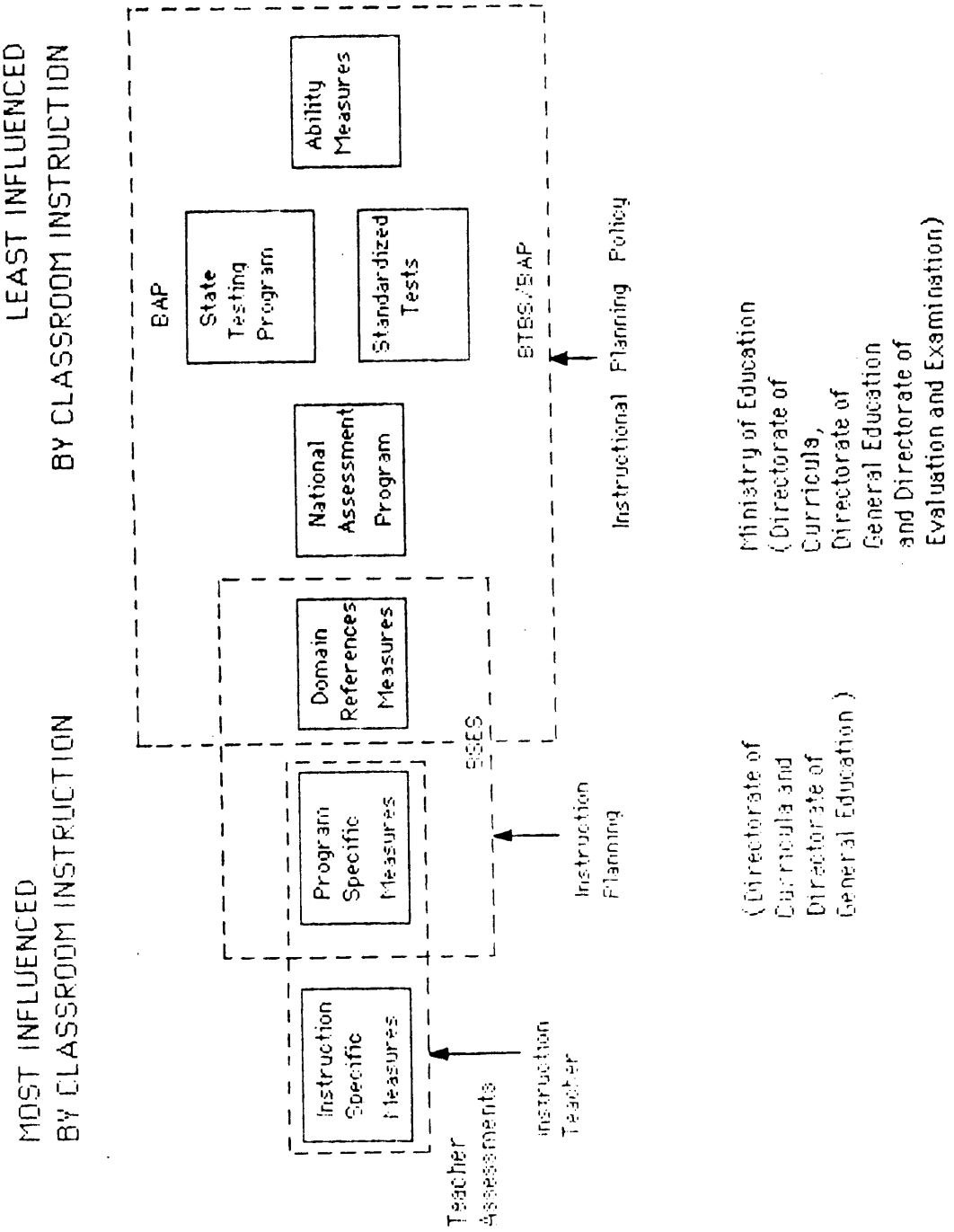
The implementation of a more comprehensive instructional information system in Bahrain may proceed incrementally over time. First, the teachers are already implementing instruction-specific measures. Next, the work required to implement program specific and domain referenced measures reflecting the curriculum objectives specified by the Ministry of Education has a technical base that can be used to developed the assessment. Over the longer-term, however, the work

necessary to develop the Bahrain Assessment Program will necessitate cooperation with other Arab Gulf States through the auspices of the Arab Gulf States Educational Research Center in alignment activities.

Reflection of Bahrain Elementary Mathematics Assessment Against the Technical Framework

In Bahrain, elementary school mathematics instruction is defined primarily by basal textbooks that run from grade 1 to grade 6. Moreover, it is commonly assumed that the major mathematics textbooks provide adequate and comprehensive coverage of the important mathematical topics or skills (Chall, 1977; Freeman et al., 1983; Keith, 1981). It then follows that teachers need only to follow textbook instruction in order to be successful. In the hands of a well trained teacher, a mathematics textbook can be a resource for developing all necessary learning experiences. However, research findings provide evidence that some mathematical topics are not covered or only partially covered in textbooks (Buchanan, 1982; Buchanan et al., 1983; Harris, 1980; Kuhs & Freeman, 1979; Freeman et al., 1983; Schmidt, 1983). For example, Buchanan et al. (1983) conducted a careful analysis of mathematics textbooks and found that many critical skills were inadequately treated in the

Figure 1. Assessment model consistent with curriculum alignment (Adapted from Baker & Hanson, 1981).



textbooks, and the gaps were correlated with unacceptable general performance.

The present research study is, in large part, an initial response to Bahrain's Ministry of Education mandate to develop an entire new assessment system consistent with technical framework described above. The Ministry of Education has already prepared a new Curriculum Framework. The Framework specifies performance for each elementary grade in four subject matters areas: Arabic Language (involves reading and writing skills), mathematics, social studies, and science education. These objectives were developed over a period of years with the cooperation of groups of elementary curriculum specialists. General objectives are provided for each grade along with specific objectives for meeting the general goals. Moreover, cognitive and affective performance objectives are specified and examples are provided for each objective. The objectives are presented as emphases for the grade level at which acquisition should begin, rather than as mastery objectives (See Appendices A & B).

The principal focus of this study is to support the Ministry of Education recognition of the limitations of the present teacher-made and "cycle" tests: (1) "cycle" tests are used for promotion purposes, not individual or

program assessment. There is no analytic evidence that they reflect what was actually taught; (2) the psychometric quality of the teacher-made and "cycle" tests is not always high; (3) the teacher does not have the opportunity to re-evaluate his/her students within grade level and across grade levels since the test is not standardized; and (4) the present system does not include specific provision for placement decisions--information to guide the instructional assignment of a student in a given instructional program, progress decisions--information on the student's learning status during the course of instruction, and attainment decisions--acknowledges that notable student learning has (or has not) occurred in the instructional program (Hanson et al., 1980).

In sum, the present status is as follows:

1. The new curriculum framework has been developed, but not evaluated.

2. The teacher-made and cycle tests have been deemed psychometrically inadequate.

3. The lack of an adequate theoretical and technical undergrinding of the assessment and evaluation system has been recognized.

4. It has been recognized that the objectives must be aligned with the assessment, and instruments must be

designed to measure these objectives in order that the purposes of mathematics education at elementary schools be met.

Statement of Problem

Application of Curriculum Alignment technology will be used to study the relationships between objectives, instructional transactions and assessment procedures in Bahrain elementary schools mathematics instruction. This technology will also be used as a means for examining the alignment of curriculum, instruction, objectives and assessment. It will be used as an analytic goal to identify "gaps" in the development of critical student mathematics skills and performance--with influences as to what adjustments must be made in the objectives and instructional components. Thus foundational to this study will be the construction of assessment instrumentation that accurately represents the curriculum and mandated instructional guidelines.

In addition to the above analyses, four important questions will be addressed:

(1) Are there empirical gaps in student performance that suggest inadequate textbooks coverage across grade levels?

(2) Are there differential patterns of performance associated with student gender?

(3) Does teacher-classroom organizational structure differentially influence student performance?

(4) Is there a significant interaction between gender and classroom organization?

The present study is an initial response to recognition by the Ministry of Education of a need for a comprehensive instructional information and improvement system that reflects current psychometric theory and practice. The study will:

(1) specify a comprehensive framework of the Ministry's mathematics curriculum objectives,

(2) correlate the adopted textbooks and their coverage of the Bahrain mathematics curriculum at the elementary level,

(3) construct psychometrically adequate assessment instruments that measure the mathematics curriculum objectives within the comprehensive framework,

(4) determine misalignments and/or important gaps in the textbooks as reflected against the curriculum objectives, and student performance,

(5) describe the cumulative progression of mathematics skills development across grades and relate it to the range of alignment information,

(6) identify possible critical skills development problems that are, in part, a function of identified misalignment, and

(7) determine if there are differential performance characteristics of males and females under two classroom organizational structure (self-contained VS. departmentalized).

Definition of Terms

The following terms are pertinent to this study:

Bahrain Assessment Program. A large scale "standardized" testing program to assess student performance relative to stated educational goals.

Comprehensive program-referenced test. A test for which: (a) content has been selected and checked empirically, (b) norms have been established, (c) uniform methods of administering and scoring have been developed, and (d) may be scored with a relatively high degree of objectivity (Good, 1973, p. 603).

Domain-referenced measure. A measure with items referenced to one or more defined instructional domains.

Instructional planning. The Directorate of Curricula definition of this term by the materials such as textbooks and syllabi.

Instructional planning policy. Refers to a Ministry of Education Act, which represents the content domains that should be learned by all students.

Instruction specific measure. A measure with items referenced to instructional activities students directly experience.

Pattern of achievement. Kinds of skills that the different student groups: (a) have learned well, (b) are enroute to learning, and (c) have not learned at all (Milazzo & Buchanan, 1982, p. 35).

Program specific measure. A measure with items referenced to objectives of a particular instructional program.

Sampling the key mathematical concepts. Refers to the following steps: (a) determine the skills and concepts assessed, (b) designate the item format for each skill/concept, (c) specify boundaries for each skill/concept, and (d) specify the item sampling plan based on instructional emphasis (Hanson et al., 1980).

Teacher assessment. A measure with clearly defined learning outcomes that are in harmony with instructional objectives (Gronlund, 1982, p. 8).

Delimitations and Limitations

1. The study was limited to: (a) children between the chronological ages of 6 and 10 years old in Bahrain (b) children enrolled in the regular first four grades of Bahrain elementary schools, and (c) twelve elementary schools for boys and the same number of schools for girls.

2. The reliability and validity of the assessment instruments used in the study will affect the outcomes of the study. These characteristics were investigated and confirmed as a part of the study.

3. The 24 schools used in this study do not include the entire population in Bahrain schools. Generalization will be confined to intra-sample comparisons.

Organization of the Remainder of the Study

The dissertation is organized in the following manner:

Chapter II presents a review of literature. The first section of the review covers the assessment components. The second section discusses instructional components and a description of how these elements function in Bahrain. The third section focuses on the

interrelationship of assessment and instruction. The fourth section summarizes the instructional gaps in student mathematics performance. The final section discusses the association of sex differences and the classroom organizational structure (self-contained VS. departmentalized) with student mathematics achievement.

Chapter III describes the methodology utilized in the study. This chapter includes population and sample, research instrumentation; covering; plan, design and construction of the test; item pool, description of the four test forms; and statistical analysis. Then the statistical procedures, test administration and translation procedures are presented.

Chapter IV contains a description and discussion of the results of the study. First, the result of the curriculum mapping by topics and grades are presented. Second, student test performance is described across grade levels by topics; including; major learning problems in the mathematical topics across grade levels Third, instructional gaps based on student performance within grade levels by topics and an analysis of the role of specific instructional gaps in student learning across grade levels by topics are presented. Fifth, a series analysis of variance investigating the association of student gender and classroom

organizational structure with test performance described. Finally, a discussion of the foregoing data is presented.

Chapter V consists of a summation of the study with conclusions and recommendations derived from the study.

References are listed for sources cited and resources consulted.

Appendixes presents an english translation of the "old" and "new" mathematics curriculum for Bahrain elementary schools (grade 1 to grade 4); curriculum mapping by mathematical topics and grades; Arabic and English versions of test booklets at each grade level; Arabic and English versions of standard test administration direction; Arabic and English versions of requested letters to teachers and principals; Arabic and english versions of appreciation letters to teachers and principals; and three kinds of tables: Point-biserial correlation coefficients of test-items analysis by grade levels, Pearson Product Moment coefficients for inter-topic and total test scores, and Pearson Product Moment of inter-item correlations at each grade level.

CHAPTER II

REVIEW OF RELATED LITERATURE

This review is organized consistent with the technical framework and model which undergird the study. It treats the assessment components and instructional components of the model and includes a description of how these elements function in Bahrain. It treats the interrelationships of assessment and instruction that are basic to the technical framework. It describes commonly occurring gaps in student mathematics achievement. Then it treats the association of sex differences and of classroom organizational structure with student performance in elementary school mathematics.

Assessment Components

Tests and examination have traditionally served as a major means of setting and maintaining educational standards, probably in all cultural settings. They do this by monitoring the performance of individual student. Tests not only assess student progress and performance, they also serve as a mean of selection and placement in programs, and influence students' self-

perception (Hanson et al., 1980; Gay, 1985; Gronlund, 1982; Linn, 1983; Mehrens & Lehmann, 1987; Resmick, 1982; Singer et al., 1982; Thorndike & Hagen, 1977; Tyler & White, 1979). Moreover, they reflect upon the competence and efforts of professional educators. In addition, tests operationally define the goals of education, tend to control and regulate what is taught and emphasized in the curriculum, and provide information that influence public policy decisions on education (Airasian, 1987; Bock et al., 1982; Mehrens, 1984). They also inform the public on the efficiency and effectiveness of the schools in attaining educational goals (Airasian, 1987; Baker & Schutz, 1971; Gay, 1985; Mehrens & Lehmann, 1987; Schmidt, 1983; Singer et al., 1982).

Well-constructed achievement tests reflect four general principles derived from psychometric theory and research. First, achievement tests must reflect instruction. This is easy to say, but it is not easy to do. Gronlund (1971) states a classical thesis:

> In measuring the extent to which students are achieving course objectives, we have no absolute standard by which to determine their progress. A student's achievement can be regarded as high or low only by comparing it with the achievement of others students (p.139).

More recently, however, developers of achievement tests used in instruction have sought to construct test items that closely reflect the intent of instruction (Gullikson, 1984; Hanson et al., 1986; Messick, 1975, 1985; Roid & Haladyna, 1980; Suhor, 1985; Thorndike, 1982). To develop an instructionally relevant achievement test, five steps are viewed as essential. The first step is the conceptualization of the reason for instruction and/or testing--identifying a relevant domain of information and/or skills to be learned as the result of instruction (e.g., mathematical topics/performance across grade levels). The second step involves the conceptualization of what is to be taught--instructional intent is transformed into either (a) instructional objectives--behaviors to be elicited by learners (e.g., mathematical instructional objectives across grade levels) or (b) a specification of the content domain to be learned (e.g., mathematical subskills across grades). The third step involves the development of the items--a universe or domain of test items which adequately represent the instructional intent (e.g., development of 150 items for a mathematics test). The fourth step involves reviewing, identifying and improving items before they are employed in testing (e.g., 100 items have been improved by curriculum

mathematics specialists). The final step is the selection of items for a test--for example, drawing a random sample of items from the domain of items (e.g., the final item pool).

Secondly, tests need to be based on learning principles, have relevance to the current and future needs of the student, produce measurable information and indicate the resulting instructional strategies (Feldhusen et al., 1976; Leinhardt & Seewald, 1981; Mehrens, 1984; Popham, 1971; Singer et al., 1982).

Thirdly, an instructional program should provide preparation such that all of the examinees could answer all the test's items correctly. Yet reality suggests that such instructional perfection rarely exists (Horne, 1984; Leinhardt & Seewald, 1981). At one extreme, we can think of a situation in which all students are provided with sufficient instruction to pass all items on a test (i.e., adequate preparation). At the other extreme we can imagine a test for which students are never prepared during instructional sequence (i.e., inadequate preparation). But what about the real world of education where some skills tested are given ample attention and some are not? How much emphasis, or classroom time, must a tested skill receive before we can say, at least for that particular skill, that

adequate preparation has been provided? (Hardy, 1984; Milazzo & Buchanan, 1982; Yalow & Appel, 1983).

Fourthly, a test will have instructional validity if (a) the knowledge of the performance domain has been specified, and (b) it can be shown that well-conceived instruction has been provided for the attainment of each objective related to the knowledge of the performance domain, which includes: (1) the instruction is of sufficient quality to assure an opportunity to learn, and (2) it aligns the behavioral specification of the objectives (Cooley & Leinhardt, 1980; Feldhusen et al., 1976; Freeman et al., 1983; Leinhardt & Seewald, 1981; Yalow & Appel, 1983; Yalow & Popham, 1983). However, Hardy (1984) states:

> Most educators will agree with the appropriateness of instructional validity criterion. Logically it is not fair to require students to know content that they have not been taught. However, evidence of instructional validity has not typically been gathered, analyzed, and quantified as part of the test development processes (p. 20).

Various types of tests have been conceived and developed to provide a comprehensive instructional information system: Teacher-made tests, norm-referenced tests (standardized tests and ability tests), and criterion-referenced tests (domain-referenced tests and specific program measures). In the following sections a

brief description of each test type is presented. Moreover, at the end of each section a description of the current assessment in Bahrain elementary schools is followed.

Teacher-Made Tests

Learner performances on teacher-made tests is a fairly straightforward instance of a non-standardized measuring device. Typically, such tests are used in a single classroom rather than in large-scale evaluations of instructional programs (Baker & Schutz, 1971; Green, 1963; McKee & Manning-Curtis, 1982; Mckillip, 1979; Quinto, 1977).

Teacher-made tests typically have the following characteristics: (a) Usually no uniform directions are specified, (b) Both content and sampling are determined by the classroom teacher, (c) They may be hurried and haphazard; (since the construction of the test did not involve such factors as blueprints, item tryout, item analysis or revision), (d) Reliability is generally not known, (e) Only local classroom norms are available, and (f) They are best suited for measuring particular objectives set by the teacher and for intraclass comparison (Gay, 1985; Green, 1963; McKee & Manning-Curtis, 1982; Mehrens & Lehmann, 1987; Thorndike & Hagen, 1977).

In contrast to the Western practice, teacher-made tests in Bahrain depart from these characteristics in several ways. First, the purpose and use of these tests are only for promotion of the students from one grade to the next. Second, these tests at mid-year or end-of-year usually cover a single unit work course. Third, the tests do not reflect what actually goes on in the classroom, because they lack an adequate psychometric foundation (validity and reliability). Finally, the teachers and curriculum specialists have not been trained to be test makers.

Instruction Specific Measures

Baker and Schutz (1971) define an instruction specific measure as based on: "outlines listing instructional and assessment conditions for implementing learner attainment of given instructional objectives" (pp. 67-68). Research by Hively et al. (1968, 1974) and Baker and Schutz (1971) provides the background and experiences for the utility of the instructional specification in the development of instruction and assessment.

Baker and Schutz (1971) describe the usefulness of the instructional specification to the curriculum program development: "Curriculum programs that are developed properly from a set of written instructional

specifications will incorporate the instructional and assessment techniques directly into program materials and procedures, thereby increasing the probability of high learner achievement of instructional objectives" (pp. 67-68).

A set of instructional specifications for an instructional program serves a blueprint function for developing the instructional program (Baker & Schutz, 1971; Bock et al., 1982; Roid & Haladyna, 1980). A well-constructed instructional specification for an instructional objective includes five components: (1) objectives--the outcomes the learner is expected to acquire as a result of instruction, (2) cue--the information the learner must have to attain proficiency, (3) mastery items--items used to (a) provide learner practice of the desired behavior and (b) assess learner ability to perform the behavior, (4) mastery limits--includes (a) correct response--the defining characteristics of the correct responses choice for desired behavior and (b) incorrect responses choices to the behavior, and (5) entry skills--the skills that the learner must possess before receiving instruction for the present objective (Baker & Schutz, 1971, p. 68).

However, the procedures of an instructional specification of objectives require more time than is

available to many teachers. Baker and Schutz (1971) suggest that teachers may simply include the components of a good instructional specification in his/her instruction relating to the objective, rather taking the time to write an instructional specification for each objective.

In Bahrain on the other hand, the Ministry of Education specifies the specific instructional program in a written document (Syllabi) which addresses all the objectives and general goals for each subject matter at each grade within each educational level. The syllabi can serve as a planning guide in developing instructional specific measures (Ministry of Education, 1984). However, present syllabi focus solely on one component of the curriculum--objectives (See Appendixes A & B).

Domain Referenced Measures

Although all good achievement tests are objective-based, very few can truly be called domain-referenced. In constructing such tests, one defines a content domain (but generally not with complete specificity) and write items measuring this domain (Mehrens & Lehmann, 1987). The distinction currently made between "norm-referenced" tests and "criterion-referenced" tests is based on the degree of precision in specifying the content domain and

on the item-generating rules for sampling from that domain (Berk, 1980; Gay, 1985; Gronlund, 1982; Haertel, 1985; Hambleton et al., 1978; Horne, 1984; Mehrens & Lehmann, 1987; Popham, 1978, 1980; Thorndike & Hagen, 1977).

Mehrens and Lehmann (1987) consider the differences between criterion-referenced test and norm-referenced tests pertain to the breadth of the domain:

> A typical norm-referenced achievement test is a survey instrument covering a broad domain, such knowledge of the basic arithmetic functions of addition, subtraction, multiplication and division, each with whole numbers, decimals fractions, and common fractions. ...One could think of 12 subdomains and sample from each when constructing the test. ...While a typical criterion-referenced test would be likely to cover only one of these subdomains, or perhaps an even more specific domain (such as horizontal addition of two-digit numbers to two-digit numbers (p. 18).

In Bahrain, the distinction between norm- and criterion-referenced tests is not made. Bahrain educators cannot recognize the differences between criterion-referenced and norm-referenced tests when they construct or develop such tests. Most test ("cycle" or teacher-made) interpretations are implicitly norm-referenced regarding the student's promotion from one grade to the next.

State Assessment Programs

In the United States, California students, for example, take state-mandated, school districts, and teacher-made tests from grade 1-12 (Airasian, 1987; Singer et al., 1982). In contrast, Bahraini students take the Ministry of Education-mandated and teacher-made tests from grades 3-12 (Ministry of Education, 1981-82). The California state-mandated test, constructed and administered by the State Department of Education's California Assessment Program (CAP), is called the Survey of Basic Skills (SBS). It is given annually to each public school student enrolled in grade 1, 3, 6, and 12 (Airasian, 1987; Singer et al., 1982). In contrast, the Bahrain-mandated tests are administered by the Directorate of Evaluation and Examination and given annually to students enrolled in grades 6, 9, and 12.

Standardized Achievement Tests

Standardized achievement tests have several features: (a) Specific administration and scoring procedures; (b) Content determined by curriculum and subject-matter experts; (c) Items written or at least edited by specialists; (d) Reliability generally high (often over .90) and small standard errors of measurement; (e) Interpretive aids can be quite elaborate, ranging from a few suggestions to detailed

remedial strategies; and (f) Norms, typically make available national, school district, and local norms (Gay, 1985; Grondlund, 1982; Hanson & Schutz, 1986; Kellaghan et al., 1982; Mehrens & Lehmann, 1987; Wilson & Hiscox, 1984).

Historically, standardized achievement tests have been used primarily to assess individual performance independently of the programs or curricula to which individuals were exposed (Gronlund, 1982; Resmick, 1982; Rush, 1929; Schmidt, 1983; Thorndike & Hagen, 1977; Tyler & White, 1979). From that perspective, there was little concern for the relationship between test item content and the content of instruction (Buchanan et al., 1983; Haertel & Calfee, 1983; Wilson & Hiscox, 1984).

Thorndike (1971), in reviewing developments in achievement testing from 1950 to 1970, concluded that:

> Test and item formats have changed little over the twenty-years span. ... The range of content and objectives measured by current tests has not been greatly extended over what was included twenty years ago. The basic techniques of test construction are much as they were then. ... Developments in test theory have been evolutionary rather than revolutionary. ... The art is changing and growing, but it is the same basic art (p. 13).

Comparing standardized achievement testing from 1927 to 1977, Buros (1977) stated that: "Essentially, achievement tests are being constructed today in the

same way they were fifty years ago. ... The major changes being the use of more sophisticated statistical procedures for doing what are did then--mistakes and all" (p. 10).

Though standardized testing has doubtless been a huge success in terms of the proliferation of tests and the use of tests by educational institutions, this success has also been a weakness; testing seems to have become infected with the inertia of those institutions and to have progressed little from where it stood decades earlier (Airasian, 1987; Mehrens, 1984; Messick, 1985).

In Bahrain, standardized tests are not presently part of the assessment system. Thus it is possible to start with a clean slate in introducing this component of a comprehensive instructional information system in the future.

National Assessment Program

Established in the 1960s to assess the conditions and the purpose of education in the United States, the National Assessment of Educational Progress (NAEP) collected data for the first time in 1969. Since then, over a million 9-, 13-, and 17-year-old students have been assessed in a variety of subjects such as reading,

writing, mathematics and science (Anderson et al., 1982; Bock et al., 1982; Messick, 1985).

The original NAEP architects developed a sampling plan insuring that no student would take more than a small sample of diverse exercises. First, they capitalized on the strengths of matrix sampling to insure comprehensive coverage of subject matter for population groups. Second, they insisted on analysis and reporting at the exercise level so that the focus would be not on curriculum units or knowledge and skill domains but on specific learning outcomes. Finally, the assessment was organized in terms of age levels rather than grade levels, which has a number of important points in its favor but departs from the usual way in which school are organized, state and local assessment are reported, and educational policy is formulated (Bock et al., 1982; Singer et al., 1982; Messick, 1985).

Average percent correct is reported for sets of items sampled from specified domains and students sampled from specified populations (i.e., the matrix samples). This approach has the obvious advantage of reducing the data to manageable proportions; the large array of individual, ungeneralized item statistics is replaced by a small number of easily reported, broadly interpretable indices of attainment (Messick, 1985).

The results of assessment mainly have been reported as skill and content area average percent correct. In NAEP reports, these figures are studied mostly for what they show of trends in attainment over the 4-year periods between assessments devoted to the same subject matter (e.g., mathematics). In the state assessments, they are used primarily in annual comparisons of schools or school districts (sometimes in the form of percentiles) but also in checking year-to-year trends.

In Bahrain, there is presently no counterpart for NAEP. Again, introducing the component in the future can build upon United States experiences and avoid past errors.

Instructional Components

The following sections are referenced to the instructional aspects of the instructional information model which is foundational to the study. The final section references the current status of curriculum and instruction in Bahrain.

Classroom Instruction

Classroom instruction is the focus on an immediate or a micro set of interactions; the teacher designs an immediate set of learning experiences to achieve specific objectives (Bloom, 1956; Bruner, 1966; Cooley &

Leinhardt, 1980; Driscoll, 1981; Slavin, 1987a, 1987b; Tennyson & Park, 1980). The knowledge of what actually goes on during classroom instruction is very limited; few studies describe the actual situation (Durkin, 1978; Gibney & Karns, 1979; Stake & Easley, 1978; Stiggins & Bridgeford, 1985; Stigler et al., 1987). Thus cross-cultural comparisons are inappropriate. However, evidence from Western settings indicates that mathematics instruction, for example, has changed little over the past 25 years, despite innovations advocated (Baroody, 1987; Gibney & Karns, 1979). The self-contained classroom at the elementary school level is still the dominant pattern for mathematics instruction (Check & Castle, 1981). The same situation appears to hold true in Bahrain. According to Fey (1979), a great majority of elementary teachers believe that their sole responsibility in mathematics teaching is to develop student facility in arithmetic computation.

Typical elementary textbooks have expanded from arithmetic to mathematics with the addition of such topics as geometry, measurement, probability and statistics, sets and properties of number system (Gibney & Krans, 1979; Milazzo & Buchanan, 1982). However, computation with whole number, fraction, and decimals remains the core of the elementary school curriculum

(Baroody, 1987). Again, the same situation appears to hold true in Bahrain.

Research surveys and analyses of mathematics, for example, textbooks and their use reveal some expected findings, as well as a few surprises (Harris, 1980; Freeman et al., 1983, 1985; Kuhs & Freeman, 1979; Suydam & Osborne, 1977). In their survey of the 20 year span from 1955 to 1975, Suydam and Osborne (1977) found that a single text is used in most classrooms and that many teachers use no instructional materials except the textbook and chalkboard. They found that the major mathematics texts in use throughout the country are similar in several ways: (a) low-level cognitive processes--knowledge and comprehension--are used more frequently then high-level processes--for example, in problem solving processes, (b) an emphasis on computational skills is apparent, (c) there is considerable agreement on grade placement, sequence and presentation of basic topics and (d) they are based on "conventional wisdom" rather than research and development (Cited in Driscoll, 1981). Again, the same situation appears to hold true in Bahrain (Ministry of Education, 1981-82).

Instructional Planning

This level represents the operational definition of the content domain in terms of instructional materials and textbook (Linn, 1983; Schmidt, 1983). To implement this operational definition some important steps should be taken into consideration: First, a grade-by-grade mapping of curriculum objectives and grade-by-grade mapping of textbook content should be completed. Second, a program specific measure should be designed to achieve the content area that are covered by the assessment. This program might be broken into narrow subdomains or elements referenced to the objectives of a particular instructional program (e.g., mathematics). However, to approach this kind of program, previous research has indicated that the analysis of the textbooks tended to show the relationship of instructional objectives and the assessment outcomes (Freeman et al., 1983; Kuhs & Freeman, 1979; Law, 1982; Sindler etal., 1984). One way to examine the skills coverage of a textbook is to use the information provided in correlation charts. Many publishers provide correlation charts for their textbook series. These charts commonly identify skills and then list page numbers where the skills are developed (Duncan et al., 1967a, 1967b; Hanson et al., 1980).

Instructional Planning Policy

This level represents the content area which educational authorities believe should be learned by all students (Linn, 1983; Schmidt, 1983; Scott, 1983; Singer et al. 1982). This level is guided by and influences assessments such as the national assessment program and the development of the standardized tests. These tests may or may not align with the instruction in particular classrooms during a specific period of time (Linn, 1983). However, standardized tests do provide indicators of general learning with little relationship to their specific program or specific instruction measures (Madaus et al., 1979).

Curriculum and Instruction in Bahrain

Most teachers are trained to plan instruction by: (a) specifying (behavioral) objectives, (b) specifying student's entry behavior (knowledge and skills), (c) selecting sequencing learning activities so as to move students from entry behavior to objectives, and (d) evaluating the outcomes of instruction in order to improve planning (Gage, 1964; Popham & Baker, 1970; Saylor et al., 1981; Sindler et al., 1984). While this perspective is a consistent feature of teacher education programs (Ministry of Education, 1986), the model is consistently not used in teachers' planning in

schools (Sindler et al, 1984). The same situation appears to hold true in Bahrain (Ministry of Education, Inservice Teacher Training, 1974).

At elementary school level, the Ministry of Education influences the mathematics curriculum in one major way; specifies performance (behavioral objectives) for all elementary grade level (1 thru 4) in the subject matter of mathematics. These objectives were developed over a five year period and are published in a handbook that is organized by subject matter topics. General objectives are provided for each grade by specific objectives to work toward meeting the general objectives. Moreover, cognitive and affective performance objectives are specified and examples are provided for each objective. The emphasis is placed on specifying the grade level at which acquisition should begin. In the preface to the handbook (curriculum guide), the following statement outlining its goals:

> The handbook has been developed by the Directorate of Curricula with teachers as its key targets. As such, it is hoped objectives are in a form that will be most helpful to teachers in a) providing an overall scope of a subject matter in a total and by grade level, b) establishing their own classroom and student objectives, c) developing their own classroom tests and d) designing and developing their own classroom activities (Ministry of Education, 1986; p. 1).

The planning that subject matter (e.g., mathematics) teachers in Bahrain elementary school do is usually of a short term nature. This mainly includes daily planning. The Ministry of Education requires that each teacher keep a plan book or sheet with daily lessons. They are to keep these plan-books on their desk so as to be available if they have to be called for the subject-matter advisor or the principal. Most of this planning is intertwined with setting up activities, writing assignments on the board, and so forth. Moreover, not all mathematics teacher's classroom-related activities involve daily planning.

Typical lesson. The framework of the lesson plan is 3 X 3 matrix: Horizontally, it includes objectives, activities and assessment, while vertically, it consists of introduction, presentation and summary. The following is an example of a typical lesson plan:

> First, vertically: (1) Introduction (recall the relationship between centimeter and millimeter), (2) Presentation (recognize one-tenth decimal; express common fraction of denominator of ten is a decimal number; possess the ability to read/write decimal number), and (3) Summary (solve some mathematical exercises). Second, horizontally: Objectives (recall the relationship between centimeter and millimeter), Activities Questioning for children, verbally about some easy exercises such as how many fils in ten fils coin? evaluation solve some mathematical exercises on chalkboard, all ideas were encouraged (introduction).

Interrelationship of Assessment and Instruction

The relationship between what is taught and what is tested requires the following considerations: (a) details of curriculum materials (b) an allocation and efficient use of time, (c) structure of classroom management, (d) nature of teacher feedback and reinforcement to the student, and (e) the degree of classroom flexibility (Airasian, 1987; Airasian & Madaus, 1983; Baker & Schutz, 1971; Berliner, 1980; Driscoll, 1981; Floden et al., 1978; Linn, 1983; Madaus et al., 1979; Mehrens, 1984; Singer et al., 1982; Slavin, 1987a, 1987b).

The way to review the relationship between testing and instruction, Schmidt (1983) pointed out, is dependent upon the purpose of the testing: (1) If the purpose of the testing is to estimate a true score, based upon instructional planning policy and instructional planning, the relationship of the instructional content domain to the test content can be used as an index of instructional opportunity which contributes to a better understanding of student performance. It is not an issue of validity. And (2) If the purpose of the testing is to estimate a true score defined in terms of instructional domain or in

terms of the curricular domain, the relationship of test content to instructional and/or curricular domain is an issue of bias and hence invalidity.

Linn (1983) considered briefly some features of classroom tests, suggesting that the links between tests and instruction are generally stronger and more obvious in teacher-made tests than with a standardized testing program. This is because in standardized testing programs the following common features of classroom tests are often lacking, and their absence weakens the link between testing and instruction: (a) the degree of alignment between test items and instructional objectives; (b) the use of test results to provide feedback to the students and to the teacher; (c) the use of tests to flag facts or concepts that are considered important; and (d) the use of tests to determine grades.

Popham and Lindheim (1981) argued that if a test domain is described very generally, it is relatively easy to align the domain to curriculum and instruction. If, however, the test domain is spelled out with great care and specificity, it will be more difficult to align the domain with curriculum and instruction. In contrast, Arasian and Maduas (1983) pointed out that the issue of level of domain specificity is different from the issue of the level of transferability of the skill

or construct the test is intended to measure. The more general and transferable the skills, the harder it may be to align them with any specific course, or instructional program, particularly at the high school level.

Freeman et al. (1983) compared the content of fourth-grade textbooks with the content of several widely used standardized tests. After measuring how well the test and texts aligned on their respective items, they concluded that no one test is equally well suited for the textbooks. As a matter of fact, some striking misalignment were detected. One implication is clear: It is unwise to assume that standardized tests cover what being taught, or that a text covers what is tested. Moreover, under certain conditions it seems clear that testing can have much more direct impact on educational practice. As Madaus (1981) pointed out on commenting on recent research of test use:

> Whenever test results become a key element in important decisions that affect individual life chances (e.g., graduation from high school, grade-to-grade promotion, teacher salary or school certification), the agency that administers the test assumes a great deal of power over the schooling process. When external tests are used in these ways, administrators, teachers and students take the results seriously and modify their behavior and attitudes accordingly (p. 635).

However, teachers are still skeptical about the values of external assessment information yielded by tests not devised by themselves (Perrone, 1977). In Bahrain, a teacher's toleration of external test instruments is related to: (a) some personal problems (e.g., linked to their salary, promotion...etc), (b) centralization of the curriculum, (c) standardization of textbooks, or (d) teachers could be aware of the advisor evaluation of the subject-matter might know that they are not following the curriculum guidelines or that they are unable to utilized the texts effectively.

Gaps in Mathematical Achievement

It is possible to trace back the particular prerequisite skill or concepts involved in mathematical achievement. For example, if a student does not understand place value tasks involving hundreds, tens, and ones, then the student needs to be able to: (a) order number form 100-999, (b) interpret place value of the 3-place numeral, (c) write numeral in the hundreds and (d) exchange tens for hundreds for tens (e.g., 17 tens is hundred and 7 tens) (Driscoll, 1981).

The prerequisite of both informal and formal skills should receive instructional attention. For example, in order to mentally compute from 6 - 1 to 10 - 1; the

child must first have efficient use of the mental number line to determine ("n before" and "n after) relationships. A deficiency in determining these relationships can be instructed through various activities and games (Baroody, 1987; Driscoll, 1981; Resnik & Ford, 1981).

Hazekamp (1978) lists a hierarchy of steps for teaching the multiplication algorithm such as: (1) knowledge of basic multiplication facts, (2) the structure of the base-ten system, and renaming skills and (3) multiplying multiples of 10 and multiples of 100 by ones. Within each step he presents a number of suggestions for mastery on concrete, pictorial and symbolic levels. For example, in step 3, base-ten blocks (single small cubes are ones blocks, strips of 10 ones block together are tens blocks, and so on) are used to illustrate the connection between 3 X 4 = 12 and 30 X 4 = 120 (Cited in Driscoll, 1981).

A common production difficulty is the "no-stop error": Not stopping the counting process after reaching the target. Such no-stop errors have been attributed to memory failure (Resnick & Ford, 1981). This can be counteracted by appropriate instruction. Specifically, Baroody (1987) suggests that children should master each counting skill to the point where it

is automatic--This is essential because count skills build on one another and serve as the basic of other complex skills. If basic skills are not efficient, they cannot be effectively integrated with other skills to perform more complex functions (pp. 98-99).

Enumeration errors may arise from three sources: (a) generating an incorrect number sequence (Sequence errors--missing tag, (b) inaccurately keeping track of counted and non-counted items (Partitioning errors)--double count, and (c) not coordinating the production of the number sequence and the keeping-track process (Coordination errors)--skipped a tag. For example, a double counting and a double tagging overvalues a set by one. It is important for teachers to observe the enumeration activity of children who are having difficulty. In addition, the most severe enumeration errors are "flurries"--denotes a combination of sequence and partitioning errors--where the child may start one-to-one process but then not maintain it, and "skims"--denotes a combination of partitioning and coordination errors--where no effort is made to execute a one-to-one process when beginning or finishing the enumeration process (Fuson & Hall, 1983).

Instruction in general computation is an important prerequisite to formal training in estimation (Ashlock,

1972): (a) the ability to round a whole number to the nearest 10 or 100, (b) the ability to multiply by powers of 10 (e.g., recognizing that 3 x 40 is the same as 12 tens or 120), and (c) the ability to add, subtract, multiply, or divide numbers, each of which is a power of 10 (e.g., recognizing that 240 ÷ 30 asks how many times 3 tens divide 24 tens and, hence, is intimately related to 24 ÷ 3). However, before these skills take form, the teacher could help children to develop a feeling for the approximate location of numbers on the number line (O'Daffer, 1979).

The learning of the basic computational facts has long been a problem for many students in all cultural setting. Brulle and Brulle (1982) stated that:

> Hundreds of ideas have been tried, yet many students find that the learning of the facts of addition, subtraction, multiplication and division is an expectionally difficult, if not impossible, task. This difficulty in learning often translates to difficulty in teaching and instruction(p. 34).

In the United States and overseas, about 40% of students in grade 3 through 6 have consistent computational bugs (errors), for example (Brown & Burton, 1978, p. 181) (See for detail; Ashlock, 1982; Backman, 1978; Baroody, 1984, 1987; Cox, 1975; Engelhardt, 1977; Roberts, 1969; Schoenfeld, 1987). In addition, Cox (1975) found that 23 percent of the

children making systematic computational errors were still making the same or very similar errors almost one year later. In her study she defined a systematic error as one which occurs "in at least three out of five problems for a specific algorithmic computation".

Roberts (1968) tried to classify errors (bugs) according to the students' method of attack (called failure strategies) which led to incorrect responses. He identified four classes of bugs: (a) wrong operation--student attempts to solve a problem with an appropriate operations; (b) obvious computational error--student attempts to solve a problem using an erroneous basic number fact; (c) defective algorithm--student attempts to solve a problem employing other than basic number fact errors or inappropriate operation errors; and (d) random response--student attempts to solve a problem in a way showing no discernible relationship to the given problem.

Engelhardt (1977) analyzed children's computational errors for 198 third- and sixth-grade students using an 84-item arithmetic computation test. He identified eight types of bugs: basic fact, grouping, inappropriate inversion, incorrect operation, defective algorithm, incomplete algorithm, identity and zero errors.

Backman (1978) provides a list of computational errors, in particular he analyzes error patterns by attending to: (a) errors related to conceptual learning (e.g., 402 X 6 = 2472. The student believes 6 X 0 = 6), (b) errors related to sequencing steps within procedures (e.g., 418 ÷ 4 = 142. The student reversed the role of dividend and divisor in part of the division), (c) errors related to selecting information or procedures (e.g., 53 X 2 = 105. The student used an addition facts, 2 + 3 = 5, within multiplication procedure) and (d) errors related to recording work (Cited in Ashlock, 1982).

Ashlock (1982) concluded that the the major reasons children learn patterns of errors is that their teachers have introduced them to paper-and-pencil procedures while they still need to work on problem with concrete aids. More specifically, he pointed that multi-digit numeration is a complex skill and there are pivotal concepts that students must learn with the help of manipulative materials before they can succeed in learning computational algorithms.

For appropriate instruction in subtraction Baroody (1987) suggests that the teacher should (a) ensure mastery of prerequisite skills for counting down, and (b) encourage the development of counting up and

flexibly choosing the more efficient computing procedures. For multiplication instruction the teacher should (a) make explicit the connection between multiplication and repeated addition, and (b) explicitly encourage skip counting, especially for large, difficult-to-compute combinations (pp. 142-154).

The two National Assessment of Educational Progress in mathematics (NAEP) (1974, 1978) revealed measurement as an area where children's skills are weak. Other studies have isolated measurement misconceptions that are common among elementary school children (See for detail; Carpenter et al., 1980a, 1980b).

In NAEP (1978) assessment glaring deficiencies showed up in the length, area and volume problems. For example, only 7 percent of nine year old in 1974 were able to find the amount of fencing needed to include a rectangular garden nine feet and five feet wide. However, in this assessment most nine year old could measure accurately with a ruler only if the length they were measuring was shorter than the ruler and was presented by a whole number on the ruler (See for detail; Carpenter et al., 1980a).

Burger et al. (1985) studied the children's reasoning within two-dimensional shapes--properties and relationship in geometry. They found that many

children: (1) rely on imprecise qualities to identify shapes, (2) refer to visual prototype to characterize shapes, (3) include irrelevant attributes when identifying and describing shapes, and (4) think of shapes as a whole without explicit reference to their components.

Ettline (1985), Ellebruch and Pyne (1978) and Lesh et al. (1983) identified two difficulties in computing with fractions operation: Reducing and renaming. For reducing and renaming, texts suggest that reducing a fraction is accomplished by dividing both terms by a common factor that does not change the value of a fraction. However, students are confused between this explanation and the operation of division of fractions where we "invert and multiply".

The results of the mathematical assessment of NAEP (Carpenter et al., 1980a, 1980b) suggested that poor performance on multi-step problems, and/or complex one-step problems requires higher-level cognitive activity. For example, Troutman and Lichtenberg (1974) listed seven specific abilities for teachers as a guide to promote student development of problem solving abilities such as: (1) Finding characteristics of objects or mathematical ideas (2) Translating a mathematical communication into different forms (3) Determining

sufficient, necessary and equivalent conditions; (4) Finding similarities and differences; (5) Making a generalization based on the observation of specific evidence; (6) Determining alternative strategies; and (7) Approximating.

From an instructional point of view, problem solving in the primary grades should have a threefold purpose to develop student's abilities toward problem solving--(a) thinking through a problem in a rational way, (b) interpreting and using information correctly, and (c) devising sensible plans to attack a problem (Spencer & Lester, 1981).

Association of Sex Differences and Classroom Organizational Structure With Elementary School Mathematics

In this section a review of the literature involving sex differences and classroom organizational structure is presented.

Sex Differences in Elementary School Mathematics

A large body of literature indicates consistent sex differences in performance in achievement areas; arithmetic, reading and social skills, for instance. Girls typically perform better on reading, while boys perform better on mathematical reasoning (Benbow &

Stanley, 1980; Eccles, 1984; Fennema, 1974; Jacbos & Eccles, 1985; Horner, 1972; Marshall & Smith, 1987). Sex differences in learning mathematics have been the focus of numerous studies over the past 10 years. These studies have revealed information about the importance of differential course work in high school (Boli, Allen & Payne, 1985), the importance of teacher interactions with boys and girls (Irvine, 1986), the nature of biological differences (Benbow & Stanley, 1980), and the function of mathematics as a filter into various career options (Sells, 1980; Cited in Marshall & Smith, 1987). None of these studies, however, adresses crucial developmental questions: Are there distinguishable and consistent sex differences in the learning of mathematics at all levels? As children mature, do the types of observed differences change? If there are differences, can we determine an order in which they develop (Marshall & Smith, 1987, p. 372).

Maccoby (1966) found that many sex differences in performance do not appear until late elementary school, or in the case of mathematics until high school.

Mathematics traditionally has been regarded as a male subject. Horner (1972) concluded that females have a motive to avoid success in traditional male areas (Cited in Fennema, 1974).

Benbow and Stanley (1980) suggested that the mathematical experiences of both males and females are identical until the junior high school years.

Moreover, mathematics is a subject in which males continue to outperform females. Although controversy exists as to both the size and the antecedents of the differences, male superiority in mathematics is seen in the upper elementary years and increases throughout high school. Male superiority increases as the difficulty level of mathematics increases and is evident even when the number of mathematics courses taken by girls and boys in high school is held constant (Fennema, 1974).

Eccles (1984) pointed out that the magnitude of sex differences in math ability strictly contrasts with the fact that gender rarely accounts for more than 4% of the variance in students' performance on standardized tests of math aptitude, and virtually never account for any significant variance in mathematics course grades during primary and secondary school years.

Classroom Organizational Structure in Elementary School Mathematics

The most advantageous organizational structure for elementary classrooms has been the subject of much discussion in educational literature (Anderson, 1962; Case, 1971; Cleavinger, 1968; Forman, 1975; Geberrich &

Pall, 1931; Jakson, 1953; Lambart et al., 1965; Price et al., 1967; Slavin, 1987a, 1987b). Departmentalization was common practice through the twenties and thirties, declined during the forties and then returned in popularity (Anderson, 1962). The departmentalized classroom organization provides a "teacher-specialist" for each subject taught. In the self-contained classroom, one teacher instructs a class of children of a given grade in all curricular areas (Slavin, 1987b).

Cleavinger (1968) found that there was a significant differences for students in self-contained at sixth-grade arithmetic applications (N=100 students) rather than for students in departmentalization. Moreover, one of his conclusions is that departmentalization does not produce significant differences in basic skill development.

Jakson (1964) found no significant difference in the arithmetic achievement of sixth-, seventh- and eighth graders under departmentalized (between-class grouping) and semi-departmentalized classroom organization. However, Gerberich and Pall (1931) reported significant differences in certain achievement areas, but with inconsistency in direction, favoring both patterns of classroom organization (self-contained and departmentalized) (Cited in Price et al, 1967). In

addition, Ward (1970) found that students in grades 4-6 learned reading and science significantly better in self-contained classes than in departmentalized classes, and there were no differences in mathematics and social studies. Unfortunately, there is very little research on departmentalization VS. self-contained in the primary grades. Case (1971) found that the achievement benefit of departmentalization, comparing fifth graders in a middle school is significant from the match control students remaining in self-contained elementary classroom.

Forman (1975) examined the relative impact of two types of educational settings: Divergent production and achievement. The subjects were 129 second graders who had continuous experience in either open or traditional self-contained classrooms. Each child was given IOWA test of basic skills. The data support that students in self-contained classromms score significantly higher than students in open-setting on the measure of academic achievement (Cited in Slavin, 1987b).

Summary

Not all achievement tests measure exactly the same thing (e.g., Baker & Schutz, 1971; Bock et al., 1982; Bookman & Iwanicki, 1983; Buchanan et al., 1983; Linn,

1983; Madaus et al., 1983; Mehrens, 1984; Messick, 1975, 1985; Schmidt, 1983). No single achievement test measure all the instructional objectives of a school. That is, there will be a taught-but-not-tested align/misalign for most tests. There will also be some tested-but-not-taught align/misalign. Because tests do not all measure exactly the same thing, the misalignment for any educational institution (school districts or Ministry of Education) will be greater, for the same degree of misalignment considerably influences norm-referenced scores. Other evidence suggests that adjusting scores to make them curriculum related has little impact on the norms.

Recall the technical framework in this study, and the abovementioned relationships among the three components of the curriculum. The need in Bahrain is a new assessment system to begin to align these components to achieve a satisfactory development of student performance in the elementary schools. In general, the process of curriculum alignment technology is tied to the following tasks. First aligning instructional materials and the activities (textbooks, syllabi) with essential skills (objectives) and other curricular materials to each student in each grade. Second, to develop a means of assessing student progress with

respect to the defined essential skills. Finally, a new system will be developed by which the data can be scored and presented in an easy-to-use form by teachers, Directorate of Curricula, and Ministry of Education staff.

CHAPTER III

METHODOLOGY

This chapter describes the (1) population and sample, (2) data resource, (3) research instrumentation; including; plan, design and construction the four test forms and item pool, (4) statistical analysis (5) statistical procedures (6) test administration, and (7) translation procedure.

Population and Sample

The immediate population consisted of all first, second, third and fourth grade classrooms in Bahrain elementary schools. The population comprises 160 elementary schools with approximately 128 classes at each of the designated grades. Schools locations include all seven geographical regions. Schools sizes range from fewer 200 students to more than 500 students. All schools were relatively homogeneous in race and age makeup: (a) in grade 1 the age mean was 6.80 years old, (b) in grade 2 the age mean was 8.00 years old, (c) in grade 3 the age mean was 9.00 years old and (d) in grade 4 the age mean was 9.90 years old.

The sampling plan was designed to yield a sample of approximately 24 classes at each grade. The final sample size was 24 classes in each grade comprising the enrollment of 24 schools. All students were enrolled in twenty four schools in the first four grades. Instruction in these schools was organized either on a departmentalized or a self-contained basis. Moreover, the teacher-students comparison included male-male, female-female and female-male staff schools.

Data Resource

Through the cooperation of the principals and teachers in the schools involved, students in the first four grades of the participating schools completed a mini-questionnaire which called for: (a) the child's name, (b) the child's chronological age, (c) the child's grade level, (d) the child's gender, (e) the school's name, (f) classroom organizational structure (departmentalized VS. self-contained), and (g) teacher's gender (Appendix D).

The mini-questionnaire was completed under the supervision of the classroom teacher who administered the test used in this study. The grade and sex distribution of the sample is shown in Table 1. The total smaple comprised 9.47 percent of the target

population (N= 35,034 students for all first four grades).

Research Instrumentation

Plan, Design and Construction of the Four Test Forms

The model underlying the four test forms reflects the Bahrain mathematics curriculum for the elementary schools (grade 1 to 4) and has no preestablished requirement for item difficulty or for the shape of a performance score distribution. The critical consideration of the design is an alignment avenue that aligns mathematics curriculum objectives (See Appendix C), assessment and the emphasis of essential mathematics skills (topics taught in Bahrain elementary schools (grade 1 thru 4). The scope and structure of the Bahrain mathematics curriculum provide the foundation for the tests independent of the statistical characteristics of items or scores. Thus the scope, substance, and format of the tests are derived from instructional objectives (essential mathematics skills) and resources to which the Ministry of Education is committed. Item formats reflect as closely as possible, highly familiar, representative practice formats included in instructional materials. The weight given to various subskills in each major topic is determined

Table 1

Grade and the Sex Distribution of the Sample

	Grades									
	1st grade		2nd grade		3rd grade		4th grade		Total	
Sex	No.	%	No.	%	No.	%	No.	%	No.	%
Males	382	11	396	12	398	12	405	12	1581	47
Females	440	13	435	13	431	13	429	13	1735	52
Total	822	25	831	25	829	25	834	25	3316	100

by the scope-and-sequence emphasis that the skill receives in the curriculum. The basic plan was to reflect representative items from different topics for the same grade level and from different grade levels within the same mathematical topics. The design thus provides instrumentation to follow across the four grade levels the growth of student performance on the topics which constitute the substance of the elementary school mathematics curriculum.

Item Pool

The test items were generated from a Bahrain mathematics curriculum at the elementary schools (grade 1 to 4). The pool includes 100 items measuring mathematical skills development and subskills areas in thirteen topics. Items were true-false and multiple-choice with four responses alternatives. Operationally, this task was accomplished through analytical work on the curriculum mathematical guide of Bahrain elementary schools (See Appendices A & B). This analysis yielded scope-and-sequence tables that comprising 13 mathematical topics. From the specification tables, items referenced to each topic were constructed to reflect the characteristics of the mathematics curriculum. The final list of mathematical skills is shown below. For each mathematical topic a brief

Table 2

Final List of Mathematical Skills and Correspondence Number of Items in the Four Test Forms

Item Sample Description	Curriculum Content
GRADE 1	
A. Size and Place Relationships	A. Size and Place Relationships
1. Which is taller?	1. Classify things according to one/two specific properties.
2. Which is shorter?	
3. Which is larger?	
4. Which is taller?	
5. Which of these are equal size?	2. Recognize place relationship.
6. Color the third car.	3. Identify an ordinal pattern.
7. Look at the pattern. Which fruit should come next?	4. Know to left/ right property.
8. Color the second swan which is on the right of the basket.	
B. Number Recognition	B. Number Recognition
9. Which set has 4?	5. Count number form 0 to 9.
10. How many?	
10. How many?	6. Count through 10.
11. How many?	
C. Number Comparison	C. Number Comparison
12. Which set has more?	7. Add 2 1-digit #
13. Which set has the same number of this set?	8. Perform "take away" subtraction with minuend 1-9.
14. Which set has one more than this set?	
15. Which set has one less than this set?	
D. Measurement	D. Measurement
16. How much money?	9. Identify local currency.
17. How much for the toy?	

(Table 2 continued)

Item Sample Description	Curriculum Content
E. Geometry	E. Geometry
18. Will this shape will match. If you fold it on the dotted line. 19. Mark the ? 20 Mark the ?	10. Show topological relationship. 11. Know 2-dimensional shapes.
GRADE 2	
B. Number Recognition	B. Number Recognition
21. How many are in this set? 22. What is the fourth letter in this word? 23. What is the number?	1. Count number to 999. 2. Extend number notation to 999. 3. Count number from 0 to 9.
C. Number Comparison	C. Number Comparison
26. Which is missing? 27. Which number come next? 28. Which number is the largest. 29. What is going in ☐?	4. Know "<", ">" or " = ". 5. Represent relation and its notation.
D. Measurement	D. Measurement
41. How much money? 42. How long? 43. What time is shown? 44. What time is shown?	6. Identify local currency. 7. Measure length.
E. Geometry	E. Geometry
45. Which is a rectangle? 46. Which is a square? 47. Which two are the same size and shapes? 48. How many sides do you see?	8. Identify simple plane figure. 9. Identify 2-dimensional figures.

(Table 2 continued)

Item Sample Description	Curriculum Content
F. Basic Facts (+,-)	F. Basic Facts (+,-)
31. Mark (✓) for the correct answer on the mathematical copmutations: Items # 31-33.	10. Possess accurately basic facts of addition/ subtraction. 11. Give sums for basic addition facts to 18. 12. Add with zero, to 18. 13. Give a difference for basic subtraction facts, to 18. 14. Give differences for 2-digits numbers, to 18.
G. Algorithm (+,-)	G. Algorithm (+,-)
34. Mark (✓) for the correct answer on mathematical computations: Items # 34-38.	15. Add three 1-digit number to 99. 16. Subtract numbers with minuend less than 1,000 with/without renaming. 17. Add three 1-digit number sums to 18. 18. Add 3-place numbers with renaming. 19. Subtract 3-place number with/without renaming.

(Table 2 continued)

Item Sample Description	Curriculum Content
	20. Subtract 2-place numbers with no renaming.
H. Basic Facts (x)	H. Basic Facts (x)
39. Mark (⌣) for the correct answer on mathematical computations: Items # 39-40.	21. Show multiplication situation related to one-to-one relationships to 5 X 5 = . 22. Give products for basic multiplication facts with number to 2 and 4 as factors. 23. Give products for basic multiplication facts with numbers to 3 and 5 as factors.
I. Fraction Recognition	I. Fraction Recognition
24. Give a fraction for a part of a region. 25. Associate fraction with congruent parts of region.	24. Identify fractional parts of a region.
J. Problem Solving	J. Problem Solving
49. Solve single statement word problems, addition application to 99: Items #77-78.	25. Solve single statement word problems.

(Table 2 continued)

Item Sample Description	Curriculum Content
50. Solve single statement word problem, subtraction application to 99: Items #s 79-80.	26. Solve single statement word problems.
GRADE 3	
B. Number Recognition	B. Number Recognition
51. What is the number? 52. How many thousands in this number 71,345.	1. Count number to 9999. 2. Give word form to standard numeral, to 99,999.
C. Number Comparison	C. Number Comparison
53. Which number comes just before 961? 54. Which number is 100 greater than 4,532 55. Round 663 to the nearest hundred?	3. Complete a sequence of numbers in consecutive counting order, to 99,999. 4. Round numbers to the nearest 100. 5. Identify numbers that are 100 "greater than" to 9,999.
D. Measurement	D. Measurement
27. Mark the value that is the same as of 5 dinars. 73. What time is shown? 74. Mark the value that is the same as of	6. Identify local money notations. 7. Recognize time units. 8. Know metric weight

(Table 2 continued)

Item Sample Description	Curriculum Content
15,000 grams.	units. 9. Give dinar notation to fils notation. 10. Give quarter hour intervals. 11. Give weight in kilograms to grams notation.
E. Geometry	E. Geometry
75. Which figure is an angle? 76. Which pair of lines is parallel?	12. Identify an angle. 13. Identify parallel lines.
F. Basic Facts (+,-)	F. Basic Facts (+,-)
59. Mark (✓) for the correct answer on the mathematical computation: Items # 59-62.	14. Show addition subtraction are inverse operations. 15. Give sums for basic addition facts to 18. 16. Add with zero, to 18. 17. Give a difference for basic subtraction facts, to 18. 18. Give differences for two 2-digit numbers, to 18.
G. Algorithm (+,-)	G. Algorithm (+,-)

(Table 2 continued)

Item Sample Description	Curriculum Content
67. Mark (✓) for the correct answer on mathematical computations: Items # 67-68.	19. Subtract numbers with minuend less than 1,000 with/without renaming. 20. Add 4-place numbers with renaming. 21. Subtract 3-place number with/without renaming.
H. Basic Facts (x)	H. Basic Facts (x)
63. Mark (✓) for the correct answer on mathematical computations: Items # 63 & 65.	22. To mulyiply with 1-5 as factors. 23. Give products for basic multiplication facts to number to 9 as a factor.
I. Basic Facts (-)	I. Basic Facts (-)
64. Mark (✓) for the correct answer on mathematical computations: Items # 64 & 66.	24. Compute basic basic division facts. 25. Give computation for basic division facts with number to 72 - 9 =. 26. Divide by zero as divisor factor.
J. Algorithm (x,-)	J. Algorithm (x,-)
69. Mark (✓) for	27. Multiply a

(Table 2 continued)

Item Sample Description	Curriculum Content
the correct answer on mathematical computations: Items # 69-71.	3-place number by a 2-place numbers with renaming. 28. Divide 2-place numbers with remainder. 29. Multiply 3-place number by 1-place number by rounding the products to nearest 100s.
K. Fraction Recognition	K. Fraction Recognition
56. Which fraction tells how much is shaded? 57. Which fraction is greater? 58. Give 1/2 of 20?	30. Identify a fractional parts of a region. 31. Identify "greater than" for a fractional region. 32. Identify a number equal to half of a given number.
L. Problem Solving	L. Problem Solving
77. Solve single statement word problem: Items # 77-80.	33. Solve single statement and multi-statement word problems: basic computational operations applications.

(Table 2 continued)

Item Sample Description	Curriculum Content
GRADE 4	
B. Number Recognition	B. Number Recognition
81. What is the number? 82. What is the place-value of 4 in: 1,483,762	1. Count number to million. 2. Give word form to standard numeral, to million. 3. Recognize place-value meaning of a digit in hundreds, thousands to millions.
C. Number Comparison	C. Number Comparison
83. What is goes in □	4. Complete a sequence numbers in consecutive counting order, to million.
D. Measurement	D. Measurement
94. How many days are in 5 weeks and 4 days? 95. What is the length to the nearest centimeter (cm). Use your ruler. 96. What is the weight in grams?	5. Exchange weeks units to days unit. 6. Extend expanded notation to metric unit: length in Cm. 7. Extend expanded notation to metric units: weights.

(Table 2 continued)

Item Sample Description	Curriculum Content
	8. Exchange units within system: Kilogram to grams.
E. Geometry	E. Geometry
97. Which figures are an congruent? 98. Which pair of lines is perpendicular?	9. Match shapes that are the same. 10. Identify perpendicular lines.
F. Basic Facts (+,-)	F. Basic Facts (+,-)
87. Which equation belongs to this family facts?	11. Identify a family for basic addition facts to 18 for a model.
G. Algorithm (+,-)	G. Algorithm (+,-)
89. Which problem can be used to check the answer to the work in the box?	12. Add 4-place number with 4-place number with renaming to, 9999 for a model.
H. Basic Facts (x)	H. Basic Facts (x)
88. Which equation belongs to this family of facts?	13. Give products /quotient for basic multiplication /division facts to 18 for a model.
I. Basic Facts (÷)	I. Basic Facts (÷)

(Table 2 continued)

Item Sample Description	Curriculum Content
89. Which equation belongs to this family of facts?	14. Give products /quotient for basic multiplication /division facts to 18 model.
J. Algorithm (x,÷)	J. Algorithm (x,÷)
90. Mark (✓) for the correct answer on mathematical computations: Items # 90-91.	15. Multiply a 3 -place number numbers with renaming. 16. Divide 3-place numbers with 1-place number with no remainder.
K. Fraction Recognition	K. Fraction Recognition
84. What is the decimal for its fraction 4/10? 85. Mark the next equivalent fraction for: 2/4, 4/8.. 86. Which fraction is equal 0?	17. Translate fractions into decimals. 18. Identify an equivalent fraction for a model. 19. Identify a fraction equal to zero.
L. Fraction Computation	L. Fraction Computation
92. Mark (✓) for the correct answer on mathematical computations: items # 92-93.	20. Add two fractions with like denominators. 21. Subtract two uncommon fraction like denominators.

(Table 2 continued)

Item Sample Description	Curriculum Content
M. Problem Solving	M. Problem Solving
99. Solve single statement word problem: Items # 99-100.	22. Solve single statement and multi-statement word: computation with weight and decimal notations. 23. Solve multi-statement word problems: computation with money involved.

definition of the subskills and the number of items generated under the topic is indicated (See Table 2).

The item pool described above was divided into four test forms referenced to each grade level (grade 1 to 4). Each form was designed to test the major mathematical objectives in each grade. Taken together, all four forms, cover the mathematical topics that appear in the Bahrain elementary school mathematics curriculum. Finally, the four test forms were prepared for administration. Thus each classroom at each grade received a test composed of representative items referenced to the mathematical topics being taught in the grade.

Description of Test Forms

Form 1 (grade 1). The test items (20 items) in this test are designed to measure the students' mathematical skills development relative to: (a) recall size and place relationships, (b) recognize number pattern and order, (c) compare numbers and sets, (d) grasp measurement concepts and (e) indicate geometrical shapes and sizes (See Appendix D).

Form 2 (grade 2). The items (20 items) in this test are designed to measure the students' mathematical skills development relative to: (a) recall number recognition, (b) recognize number comparison, (c) read

stems' direction, (d) choose between relevant and irrelevant facts, (e) select correct arithmetic computation, (f) understand geometry problems, (g) comprehend mathematical measurement topics, (h) understand the algorithm concept, (i) recall fraction concepts, and (j) work through the problem to a final solution (See Appendix D).

Form 3 (grade 3). The items (30 items) in this test are designed to measure the students' mathematical skills development relative to: (a) a degree of understand number recognition, order and comparison, (b) read stems' direction, (c) compute accurately when the four computational processes are applied in items involving whole number and fraction, (d) understand geometrical concepts and mathematical measurement concepts, (e) select correct arithmetic procedures when algorithm processes are applied involving whole numbers concepts and (f) work through the problem to a final solution. (See Appendix D).

Form 4 (grade 4). The items (20 items) in this test are designed to measure the students' mathematical skills development relative to: (a) a degree of understand number recognition, order and comparison, (b) read stems' direction, (c) compute accurately when the four computational processes are applied in items

involving whole number and fraction, and decimals, (d) comprehend geometrical concepts and mathematical measurement concepts, (e) select correct arithmetic procedures when algorithm processes are applied involving whole number concepts, and (f) work through the problem to a final solution (See Appendix D).

Statistical Analysis

The Standards for Educational and Psychological Testing (AERA-APA-NCME, 1985) states that validity "refers to the appropriateness, meaningfulness, and usefulness of the specific inference made from test scores. Test validation is the process of accumulating evidence to support such inferences " (p. 9). Content validity is related to how adequately the content of the test samples the domain about which inferences are to be made (Gay, 1985; Gronlund, 1982; Mehrens & Lehmann, 1987; Thorndike, 1982).

Psychometricians view content validity as the `sine qua non' for establishing the validity of any measure of educational achievement. This concept of validity depends on: (a) how thoroughly educational objectives have been analyzed and defined and (b) how closely these objectives have been reflected in the test items (Thorndike, 1982).

A reasonable expectation for the present study assessment instruments is that the four test forms specify with considerable detail the mathematics topics and the related subskills to each topic. Content validity was stressed during the construction of the tests. A major goal was to make sure that the test content would be in harmony with the present-day mathematics curriculum objectives and would measure relatively what is actually being taught in Bahrain elementary schools. To achieve this, there was an extensive curricular study to review thoroughly the current textbooks, curriculum guide and syllabi. The mathematics topics measured and the related subskills at the four grade level (1-4) are as follow:

1. At grade 1 five topics (place and size relationship, number recognition, number comparison, measurement and geometry) are used. A separate score is obtained for each subskill as well as a total score.

2. At grade 2 nine topics (number recognition, number comparison, measurement, geometry, basic addition/subtraction facts, addition/subtraction algorithm, basic multiplication facts, fraction recognition and problem solving) are used. A separate score is obtained for each subskill as well as a total score.

3. At grade 3 eleven topics (number recognition, number comparison, measurement, geometry, basic addition/subtraction facts, addition/subtraction algorithm, basic multiplication/division facts, multiplication/division algorithms, fraction recognition and problem solving) are used. A separate score is obtained for each subskill as well as a total score.

4. At grade 4 twelve topics (number recognition, number comparison, measurement, geometry, basic addition/subtraction facts, addition/subtraction algorithm, basic multiplication/division facts, multiplication/division algorithms, fraction recognition, fraction computation and problem solving) are used. A separate score is obtained for each subskill as well as a total score.

Student test performance across grade levels by topics was presented in terms of percentage of correct items.

Student test performance across topics by grade levels was plotted in terms of percentage of correct items.

In order to acquire information relevant to the comparative achievement of first grade male and female to perform in five mathematics topics a series of ANOVA were undertaken. Similar analysis were employed for the

remaining grades 2-4 in four selected schools (1, 14, 22 and 24).

An item analysis of the four tests was performed using Kuder-Richardson # 20 to estimate the reliability of the topics and total score. The analysis were perform using SPSS (1981). The program also contains a subroutine for estimating the item difficulty, a subroutine for determining the discrimination index of each item and a subroutine for computing item-test point-biserial.

Summary descriptive statistics are shown in Table 3 and the item statistics are shown in Appendixes H and I.

Statistical Procedures

Scoring of the tests was done by the investigator. Accuracy of scoring, recording and converting tests results was checked by the investigator.

A series of analyses of variance were computed involving two factors: Student gender and classroom organizational structure

A series of analyses of variance were calculated involving 2 factors (student gender and classroom organizational structure) within four selected schools as a case presentation: Schools # 1, 14, 22 and 24.

Table 3

Descriptive Statistics on the Total Score of the Four Test Forms Within Grade Levels

	Grades			
	1st	2nd	3rd	4th
Category				
Number of Items	20	30	30	20
Sample Size	822	832	829	834
Means	15.10	21.60	19.90	12.40
Standard Deviations	03.20	05.10	05.40	04.00
KR20	0.761	0.822	0.828	0.774

The significance of mean achievement differences corresponding to gender characteristics and classroom organizational structure within grade levels across topics was investigated. That is, it was determined if student gender produced significantly different mean achievement results within and between mathematical topics across grade levels. Moreover, it determined if classroom organizational structure (self-contained VS. departmentalized) produced significantly different mean achievement results within and between topics across grade levels. In addition, it was determined if the interaction between student gender and classroom organizational structure produced significantly different mean achievement results between topics between grade levels. Using the 0.01 level of confidence, each of the ANOVA were examined for the presence of a significant interaction among student gender and classroom organizational structure. When a significant interaction effect was found, simple main effects were observed. However, when a significant interaction was not present, the significance of the main effects was examined.

Test Administration

Preparation for administering the tests (grade 1 thru 4) began in February, 1986, and the tests were administered on April 15th, 1986. During March, 1986 the investigator was present in the schools and classrooms of each school, meeting the teachers on the average of one day per week. During these days he discussed with the teachers the three components of the mathematics curriculum--objectives, instruction and assessment.

Before the tests were administered, several criteria were established to guide the test administration. First, teachers were told how to administer the test. Second, randomly selected teachers were assigned from different classroom organizations: self-contained versus departmentalized. Third randomly selected teachers were assigned from different school organizations: Male-male staff, female-male staff and female-female staff. Fourth, directions for administering the tests were sent to teachers one week before administration (See Appendix E). All teachers were given standard instructions as to method and timing of administration.

The tests were administered to all students who were present on the day (April, 15th, 1986) scheduled for testing. Students who were absent for any reason when the tests were administered were eliminated from further consideration in the study.

Translation Procedures

To ensure accurate translation, the following steps were taken: (1) the four tests forms (grade 1 thru 4) were translated from Arabic to English by faculty staff of mathematics in the Ministry of Education. The English Language staff, in cooperation with the Arabic Language staff, reviewed the translation and (2) the procedure was repeated until equivalent meaning of the exact original words were reproduced.

CHAPTER IV

RESULTS AND DISCUSSION

This chapter first presents the results of the curriculum mapping by mathematical topics and grades. Second, it deals with student test performance across grade levels by topics. Third, it focuses on the major learning problems across grade levels by mathematical topics. Fourth, it describes and analyzes instructional gaps based on student performance, nature of instructional gaps, instructional gaps included at only one or two grade levels, and specific instructional gaps. Fifth, it discusses the associations of student gender and classroom organizational structure with test performance. Sixth, a series of one-way analyses of variance conducted within grade levels with two factors (sex and classroom organizations) are presented. Seventh, an analysis of variance involving 2 factors: Sex and classroom organizational structure and the interaction between these two factors are presented. Finally, a discussion of results is presented.

Results

Curriculum Mapping by Mathematical Topics and Grades

The extent of the alignment degree of textbook coverage and curriculum objectives varied from adequate to no textbook coverage within the curriculum topics (See Figure 2). It should be noted that there are two kinds of skills: Easy skills (e.g., basic addition/subtraction facts) and hard skills (e.g., multiplication/division algorithms). Adequate alignment of curriculum objectives and textbook occurs when the coverage exceeds 8 pages. Partial alignment occurs when the textbook coverage is between 6-8 pages. Misalignment of curriculum objectives and textbooks occurs when the textbook coverage is less than 4 pages. The detailed map of curriculum objectives and the textbook coverage is presented in Appendix C.

Grade 1

Figure 2 depicts that for the nine mathematical topics at grade 1, three topics are adequately aligned (open-closed curves, number concept 1-9, and basic addition facts). One topic is aligned partially while the remaining topics are misaligned with textbook coverage. These topics are: Pattern, relationship of

size and place, matching one-to-one and many-to-one, set comparison, zero concept and simple word problems.

Grade 2

Figure 2 depicts that for the ten mathematical topics at grade 2, five topics are adequately aligned (basic addition/subtraction facts, place value for specific number, addition/subtraction algorithms, and basic multiplication/division facts). Three topic align partially (sets, addition/subtraction algorithm, and fraction recognition) while the remaining topics are misaligned with textbook coverage. These topics are: Measurement and metric geometry. Simple word problems are distributed through the textbook pages. However, the word problems topic overall is misaligned. Moreover, in this grade there are some subskills for each topic that inappropriately aligned. For example, two subskills related to the addition/subtraction algorithm are partially aligned: Add/subtract 2-place value number with 1-place value number with renaming and add/subtract 2-place value number with 2-place value number with renaming.

Grade 3

Figure 2 depicts that for the ten mathematical topics at grade 3, three topics are adequately aligned (sets, basic multiplication facts, and word problem

solving). Three topics are aligned partially (fraction recognition, multiplication algorithms, and division algorithms) while the remaining topics are misaligned. These topics are: Whole numbers, measurement, and nonmetric and metric geometry). Simple word problems are distributed through the textbook pages. However, this overall topic is misaligned. Moreover, in this grade there are some related subskills that are inappropriately aligned. First, two subskills related to the sets topic are misaligned. Second, seven subskills associated with the basic multiplication facts are misaligned: Relationship of multiplication operation concept and (a) repeated addition, (b) joining equivalent sets, (c) commutative property, (d) line number, (e) one, zero, and ten as factors, and (f) basic facts to 5X5 and 9X9. Third, for the measurement topic, one nonmetric subskill (money) is adequately aligned with textbook, while another subskill (time) partially aligned with textbook. Moreover, all subskills of metric measurement are misaligned with the textbook. Fourth, within multiplication algorithms all the subskills are misaligned. Similar misalignment was observed within division algorithms subskills. It should be noted that at this grade level, all simple

(easy) computational operations (basic facts) are not covered in the textbook.

Grade 4

Figure 2 depicts that for the twelve mathematical topics at grade 4, six topics are adequately aligned (sets, whole numbers, fraction numbers, decimals numbers, multiplication algorithms, division algorithms, and word problem solving). One topic aligned partially (fraction computation) while the remaining topics are misaligned with textbook coverage. These topics are: Measurement and nonmetric and metric geometry. Simple word problems are distributed through the textbook pages. However, the overall topic is misaligned. Moreover, in this grade some subskills are inappropriately aligned. First, four subskills related to the whole numbers topic are misaligned: Odd/even numbers, Greatest Common Factor, Least Common Multiple, and read/write numbers to millions. Second, one subskill associated with the addition/subtraction algorithms is misaligned: Add/subtract 9-place value number with 9-place value number with regrouping. Third, one subskill related to the multiplication algorithms is partially aligned (multiply 2-, and 3-place value number with 1-place value number with/without renaming). While for the same topic one

subskill (multiply 2-place value number with 3-place value number with/without renaming) is misaligned. Fourth, one subskill (divide 2-, and 3-place value number with 1-place value number with/without renaming) related to division algorithms topic is misaligned. In addition, for the same topic another two subskills (divide 2-place value number with 1-place value number with/without renaming and divide with remainder) are misaligned. Fifth, in fraction number concept, two subskills are partially aligned: Fraction recognition and equivalent fractions. While for the same topic, three hard subskills are misaligned (compare fractions with like denominators, with like nominators, and reduce fractions). Sixth, most of the fraction computation subskills are partially aligned. Seventh, one subskill (recognition of one tenth) is partially aligned for the decimal number concept, while the remaining subskills of this topic (one hundredth and one thousandth) are misaligned. Finally, most of the subskills associated with the measurement topic (nonmetric and metric) are misaligned. It should be noted that at this grade level, all simple (easy) computational operations (basic facts) are not covered in the textbook.

In sum, the curriculum mapping by mathematical topics and grades evidences variability in alignment

adequacy for topics and subskills across grade levels. The mapping suggests that the coverage range may be reflected in student test performance patterns across grade levels by topics. For example, at grade 1 half of the mathematical topics were misaligned with the textbooks, at grade 2, the same number are misaligned, at grades 3-4 most of the topics and their related subskills were misaligned. These misalignment degree suggest that we need to focus on the student test performance across grade levels by topics which is followed below.

Student Test Performance Across Grades Levels by Topics

Table 4 shows mean percentages for the thirteen mathematical topics across the grade levels. It reveals a relatively decrease in performance in the overall average through the thirteen topics from grade to grade. In grade 1 (five topics) and 2 (nine topics) the mean students performance was above the cutoff score (70 percent) by 6 percent and 2 percent respectively. However, in both grade 3 (eleven topics) and 4 (twelve topics) the mean students performance was below the cutoff score by 4 percent and 8 percent respectively. The decreasing mean scores from grade 1 to grade 4 appear to reflect several considerations (See Table 4).

Figure 2. Curriculum mapping by mathematical topics and grades (1-4) at Bahrain elementary schools.

Mathematical topics/ subskills	Extent of objectives/textbook alignment		
	Adequate	Partial	No text coverage
Grade 1			
Classification according to one/two specific properties: Size color, size & color.		X	
Open-close curves	X		
Pattern			X
Greater/ taller/ shorter.. than			X
Matching one-to-one			X
Set comp-arison			X
Matching one-to-many			X
Number Concept (1-5)	X		

(Figure 2 continued).

Mathematical topics/ subskills	Extent of objectives/textbook alignment		
	Adequate	Partial	No text coverage
Number Concept (6-9)	X		
Zero concept			X
Number concept (10)			X
Basic addition facts	X		
Simple word problems			X
	Grade 2		
Sets		X	
Basic addition/ subtraction facts	X		
Place value concept for specific number	X		

(Figure 2 continued).

Mathematical topics/ subskills	Extent of objectives/textbook alignment		
	Adequate	Partial	No text coverage
Addition/ Subtraction algorithm	X		
a. Add subtract 2-place with 1-place with renaming		X	
b. Add subtract 2-place with 2-place with renaming		X	
c. Add subtract 2-place with 2-place with renaming	X		
Measurement			X
a. Non-standard			X
b. Money			x
c. Time			X
Basic multi-plication facts	X		
Basic divi-sion facts	X		

(Figure 2 continued).

Mathematical topics/ subskills	Extent of objectives/textbook alignment		
	Adequate	Partial	No text coverage
Fraction recognition		X	
Metric geometry measure line/segment			X
Grade 3			
Sets	X		
a. set comparison			X
b. equivalent sets			X
Whole numbers (100-1000)			X
Basic addition/ subtraction facts			X
Fraction recognition			X
Basic multiplication facts	X		
a. related to			X

(Figure 2 continued).

Mathematical topics/ subskills	Extent of objectives/textbook alignment		
	Adequate	Partial	No text coverage
repeated addition			
b. related to joining equivalent sets			X
c. related to commutative property			X
d. related to line number			X
e. one as a factor			X
f. Zero as a factor			X
g. Ten as a factor			X
h. to 5X5			X
i. to 9X9			X
Measurement			X
1. Nonmetric			
a. Time		X	
b. Money	X		

(Figure 2 continued).

Mathematical topics/ subskills	Extent of objectives/textbook alignment		
	Adequate	Partial	No text coverage
2. Metric			X
a. Length			X
b. Weight			X
Basic division facts			X
a. related to line number			X
b. multiplication/ division opposite operations			
c. to 9X9			X
Geometry			X
1. Nonmetric			X
2. Metric			X
Multiplication algorithms		X	
a. Multiply by 10, 100 & 1000			X
b. Multiply by 10			X
c. Multiply 2-place with 1-place with renaming			X
d. Multiply			X

(Figure 2 continued).

Mathematical topics/ subskills	Extent of objectives/textbook alignment: Adequate	Partial	No text coverage
3-place with 1-place with renaming			
Division algorithms		X	
a. Divide by 10, 100 & 1000		X	
b. Divide 2-place with 1-place with renaming			X
c. Divide 2-place with 2-place with renaming			X
d. Divide with remainder			X
e. Divide 2-,3-place with 1-place with renaming			X
General practice	X		
Simple and multi-step word problems solving. Distributed within			

(Figure 2 continued).

Mathematical topics/ subskills	Extent of objectives/textbook alignment: Adequate	Partial	No text coverage
some topics (time, algorithm, and computational operations) in the text pages.			
Grade 4			
Sets	X		
Whole numbers	X		
a. Odd even numbers			X
b. Greatest common factor			X
c. Least common multiple			X
d. Read/ write numbers to millions			X
Basic Addition/ subtraction facts			
Addition/ subtraction algorithms			X
Add/subtract 9-place with			X

(Figure 2 continued).

Mathematical topics/ subskills	Extent of objectives/textbook alignment		
	Adequate	Partial	No text coverage
9-place with regrouping			
Multiplication facts	X		
Multiplication algorithms			
a. Multiply 2-, 3-place with 1-place with/without renaming		X	
b. Multiply 2-place with 3-place with/without renaming			X
Basic division facts			X
Division algorithms	X		
b. Divide 2-,3-place with 1-place with/without renaming		X	
c. Divide 2-place with 1-place			X

(Figure 2 continued).

Mathematical topics/ subskills	Extent of objectives/textbook alignment		
	Adequate	Partial	No text coverage
with/without renaming			
c. Divide with remainder			X
Fraction numbers	X		
a. Fraction recognition		X	
b. Equivalent fractions		X	
c. Compare fractions with like denominators			X
d. Compare fractions with like nominators			X
e. Reduce fractions			X
Fractions computations		X	
a. Add/ subtract fractions with like denominators		X	
b. Mixed numbers		X	
c. Transfer mixed numbers to			X

(Figure 2 continued).

Mathematical topics/ subskills	Extent of objectives/textbook alignment: Adequate	Partial	No text coverage
uncommon fractions			
d. Add/ subtract mixed numbers with like denominators		X	
Decimals numbers	X		
a. Tenth		X	
b. Hundredths			X
c. Thousandths			X
d. Add/ subtract decimals numbers			X
Measurement			X
1. Nonmetric			
a. Time		X	
b. Add/ subtract time notations			
2. Metric	X		
a. Length			X
b. Weight			X
c. Add/ subtract length notation			X
d. Add/ subtract weight notations			X

(Figure 2 continued).

Mathematical topics/ subskills	Extent of objectives/textbook alignment		
	Adequate	Partial	No text coverage
Geometry			X
1. Nonmetric			X
2. Metric			X
General practice	X		
Simple and multi-step word problems solving. Distributed within some topics (algorthims measurement, fractions,and computational operations) in the text pages.			

First, major problems involved learning mathematical concepts (topics); second, instructional gaps, particularly in complex skills at upper grades (2-4), and specific instructional gaps associated with test items; third, effects of student gender and classroom organizational structure on test performance and finally, the interaction effect between student gender and classroom organizational structure within the four selected schools. These considerations are discussed below.

Major Learning Problems in Mathematical Topics Across Grade Levels

The learning problems in grade 1 have the largest role in shaping what is learned in the upper grades, and therefore what students can be expected to accomplished. How have the upper grades responded to these problems? We must look at all grades over these learning problems.

Grade 1

Table 4 shows that 24 percent of grade 1 students (n=821) did not learn the five topics that comprise mathematics instruction at this grade. This may be accounted for by some learning problems that the children face.

A. Matching relations. This skill requires the following subskills which received inadequate

Table 4

Summary of Students Performance on Mathematics Topics Items at Grades 1-4

Mathematical topics	No. of items (Grades) 1	2	3	4	Mean % correct (Grades) 1	2	3	4
				N=	821	832	829	834
Place and size relationships	8	NT[a]	NT	NT	77	NT	NT	NT
Number recognition	3	3	2	2	88	84	77	61
Number comparison	4	4	3	1	70	66	52	65
Measurement	2	4	3	3	54	57	46	51
Geometry	3	4	2	2	81	75	85	75
Basic addition/ subtraction facts	NT	4	4	1	NT	83	85	60
Addition/ subtraction algorithms	NT	5	2	1	NT	76	57	41
Basic multiplication/division facts	NT	2	4	1	NT	83	68	57
Multiplication/ division algorithms	NT	NT	3	2	NT	NT	51	56
Fractions recognition	NT	2	3	3	NT	82	82	73
Fractions computations	NT	NT	NT	2	NT	NT	NT	80
Problem solving	NT	2	4	2	NT	52	61	49
Total	20	30	30	20	76	72	66	62

a: Not tested (NT).

instructional attention: (1) recognizing the matching relations such as; larger/smaller than and independence characteristics of these relations in size or position of the objects (items # 1-4); (2) recognizing a right from a left in place relations; (3) using matching to recognize a set of objects as that the set has as many members as a given set, has more than a given set or fewer than a given set (items # 13-15); and (4) comparing objects and check which is longer or shorter (items # 1-2).

B. Order relations--ordinal number readiness. This skill requires the following subskills which received inadequate instructional attention: (1) identifying collecting of objects in order from tallest to shortest (item # 5); and (2) following and constructing pattern based on ordering (item # 7).

C. Counting. This skill requires the following subskills which received inadequate instructional attention: (1) recognizing the number and numeral in order (items # 10-12); and (2) counting correct the elements of a set by ones and state the number in the set (items # 16-17).

D. Geometry. This skill requires the following subskills which received inadequate instructional attention: Using of a term denoting a concept. For

example, remembering the features of the various concepts; confusing between the triangle and circle concepts (items # 19-20).

Grades 2, 3 and 4

Table 4 shows that 28 percent, 34 percent and 38 percent of the total student sample in grade 2 (n=834), 3 (n=829) and 4 (n=836) respectively, did not perform well in the mathematical skills were assessed in these grades. This may be accounted for major problem learning that the children face.

A. Counting. This skill requires the following subskills which received inadequate instructional attention: (1) accumulating the counting experiences; in grade 2 items # 1-2, in grade 3 Items # 3-4 and in grade 4 Items # 1-2; (2) ability to deal with large number and to understand regrouping principles: Items # 1-2 in grade 3 and items # 2-3 in grade 4; (3) mastering the essential objectives related to counting and to understand larger numbers: Items # 6-9 in grade 2, items # 1-4 in grade 3 and items # 1-3 in grade 4; and (4) comparing larger numbers depends on an understanding of place value system of numeration. It is not always clear to children that 1,012 is greater than 989: items # 7-8 in grade 2 and item # 3 in grade 4. Thus good

knowledge of counting order is necessary if students are to avoid difficulty in comparing large numbers.

B. Geometry. This skill requires the following subskills which received inadequate instructional attention: using of a term denoting a concept. For example, remembering which operations are associated with a given concept: Continually misusing the term square, similar shapes, perpendicular lines: Items # 25-28 in grade 2, items # 25-26 in grade 3 and items # 17-18 in grade 4.

C. Computational skills. Computational skills play an important role in elementary school mathematics. Inability to compute is a great handicap to any mathematics student; the problems related to this area are as follow:

1. Problems related to incorrect procedures of performing an algorithm which are based on a fundamental lack of understanding numbers and operations: Items # 14-18 in grade 2, items # 17-20 in grade 3 and items 9-11 in grade 4.

2. Problems related to inadequate mastery of basic facts. There is no question that a major factor in mistakes by students in elementary school mathematics is an inadequate mastery of basic facts. A lack of mastery in basic facts and skills greatly limits what can be

achieved from studying mathematics: Items # 11-13 and items # 19-20 in grade 2, items # 9-12 in grade 3 and items # 7-8 in grade 4.

3. Problems related to "irrelevant rules" errors. Sometimes students get problems correct but for the wrong reasons. For example, at grade 2 on page 7 some students answered all the items in grade 2 by addition getting some problems correct but failing to distinguish between the addition and subtraction algorithms.

Instructional Gaps Based on Student Performance

A "gap" signifies a performance element missing from the body of text and instructional transaction--concept, topic and skill--that is prerequisite to mathematics being learned (Buchanan et al., 1983; Gagne`, 1977). When students have not learned prerequisite knowledge, they are severely handicapped in acquiring subsequent concepts and skills. If a student is experiencing difficulty, assuming the difficulty is not based on emotional, physical, or other "nonacademic" problems, there must be some prerequisite aspects of mathematics that the student does not understand (Driscoll, 1981). By identifying prerequisite knowledge, it is possible to determine the specific

instructional gaps that led to observed errors (discussed later within the nature of instructional gaps and the specific instructional gaps for the same skill across grade levels).

Nature of Instructional Gaps Across Grade Levels Within Topics

Here are some situations that illustrate the nature of instructional gaps between the same topic across grade levels such as: (1) same label but different, unrelated meaning, (2) same label but semi-related meaning and (3) same label with direct, prerequisite meaning.

Number Recognition

Table 4 shows an inconsistent pattern order of skill development in number recognition. The mean percentages are: For grade 1, 18 percent; for grade 2, 4 percent and for grade 3, 7 percent above the cutoff score respectively. However, in grade 4 the students performance was 9 percent below the cutoff score. The pattern may be accounted for by the following explanation:

A. Same label but different, unrelated meaning. The cause for drops in mean percentage for this topic (skill) may be related to the organization of number recognition skill development by grade level. The

headings are usually the same at each grade but the subskills assessed may be different. For example, in grade 1 the subskills of involve counting from 0 to 9. In grade 2 the number notation extends to 999. In both grade 3 and 4 the subskill involves relating a given word form to standard numeral to 99,999.

B. Same label with direct prerequisite meaning. All grades include the number recognition label. In grade 1, the subskill of counting from 0 to 9 is directly prerequisite to the grade 2 subskill of counting from 0 to 999. Students should do well on number recognition in order to be successful in learning the same subskills in grade 3 and 4. But in this case, the performance drops by 14 percent from grade 1 to 2, raise up to 3 percent in grade 3 and finally drops again by 16 percent in grade 4. This may be related to the specific instructional gaps discussed later.

C. Same label but semi-related meaning. Clearly for all grades number recognition skill is partially prerequisite to skill development at a later grade across grade levels. For example, counting from 0 to 9 in grade 1 is only partially prerequisite to develop the subskill "give word to standard numeral form to 99,999 in both grade 3 and 4".

Number Comparison

Table 4 illustrates an inconsistent pattern across the four grades for number comparison. In grade 1 a subskill is to complete a sequence of number in consecutive counting order to 10. In grade 2 a subskill is to compare two numbers using "greater/lesser than" to 999. In grade 3 a subskill is to identify ordinal number. And in grade 4 the subskill is to identify place-value of a digit in number to million. Although the same label is used, the skill has different and unrelated meaning across the grades.

Measurement

Again, the pattern in Table 4 reflects a skill with the same label but different, unrelated meaning across grades.

In grade 1 and 2, measurement items assess recognition and counting of the value of different money denomination--e.g., dinar, 1 fils, 5 fils..etc.

In grade 2 and 3, measurement items assess recognition of the value of different denominations--e.g., hour, 1/2/hour..etc.

In grade 3 and 4, measurement items assess knowledge of metric units--length in centimeter, measuring weight in grams.

Clearly, the grades 1 and 2 measurement skills are different and fairly unrelated to grade 3 and 4 measurement skills--probably not prerequisite from grade to grade. In other words, a student probably does not have to have grade 2 measurement skills (e.g., money) to be successful in learning the grade 4 measurement skill (metric).

Geometry

Table 4 shows that most students across grade levels performed were well on the geometry topic. However, some students had not yet acquired the concept or skill involved: 19 percent, 25 percent, 15 percent and 25 percent across grade levels respectively. In this situation the reason for this is not differences in relationship between skills but it may be related to other factors, such as specific instructional gaps discussed later.

Gaps Involving Complex Skills at Grade 2-4

These include the topics of basic addition/subtraction facts, addition/subtraction algorithm, basic multiplication facts, fraction recognition, and problem solving. The patterns are illustrated in Table 4. Table 4 indicates that the performance varies according to the extent of instruction provided on the topics and on the complexity

of the subskills that comprise the topic. For example, performance is very high on addition/subtraction facts at grade 2 and 3 which by this time have received a great deal of instructional emphasis. However, the performance drops at grade 4 when very large numbers and complicated computational operations are introduced. Performance on the addition/subtraction algorithm varies directly with the complexity of item nuances. The same relationships hold for the other topics. On all of the topics a large number of students have yet to acquire the skills involved.

Instructional Gaps Included at Only one or Two Grade Levels

These include (size and place relationship) included only at grade 1, (Basic division facts) included at grade 3 and 4, and (fraction computation) included only at grade 4. The patterns are illustrated in Table 4. On only two of these topics, (size and place relationships at grade 1 and (fraction computation) at grade 4 is the performance above the cutoff score of 70 percent. The patterns indicate the desirability of strengthening the instruction or otherwise modifying the curriculum relative to these topics.

Specific Instructional Gaps: Within Grades Levels Across Topics

In the following analysis, the focus was on the correct/incorrect responses to each topic with-grade-levels-across-topics. The result is based on classification of errors (bugs) (Ashlock, 1982; Brown & Burton, 1978; Marshall, 1984; Radatz, 1979; Roberts, 1969). They include a general classification of students errors within five categories: (1) errors in processing language information, (2) errors in interpreting spatial information, (3) errors in selecting appropriate procedures, (4) errors in making concept associations, and (5) errors in using irrelevant rules or information.

The present study findings suggest that most incorrect responses (specific instructional gaps) related to these errors categories.

The pattern of student accomplishment on the various topics categories at each grade levels is shown in Figures 3a-d. These Figures show differential patterns of student performance across the mathematical topics.

Grade 1

Of the five topics (size and place relationship, number recognition, number comparison, measurement and

geometry) in this grade, measurement skill had the lowest score. The low performance appears to reflect several determinants. One explanation is that the students really do not learn the target skill from instruction. Second, the students may not understand the test item format or may confused by the illustrations in the test directions.

Another explanation reflects specific learning weaknesses deriving from instructional gaps in this skill. That is the students exhibited errors in answering specific test items such as: (a) failing to identify coins correctly, (b) failing to add coins correctly and (c) counting only the number of coins.

Second, Figure 3a reflects strong alignment between curriculum objectives and the test items. On number recognition and geometry, which receive considerable instructional emphasis, performance is generally high. However, there are still some learning weaknesses deriving from instructional gaps. For example, in the ordinal number (subskill), the students count by one less or one more than the correct number in the item. These students were about 12 percent of the total grade 1 sample. Similarly, for the geometry topic, 19 percent of the sample in this grade did not answer the geometrical items correctly, exhibiting weaknesses in

choosing a shape that matches the designated shape in the stem of the question.

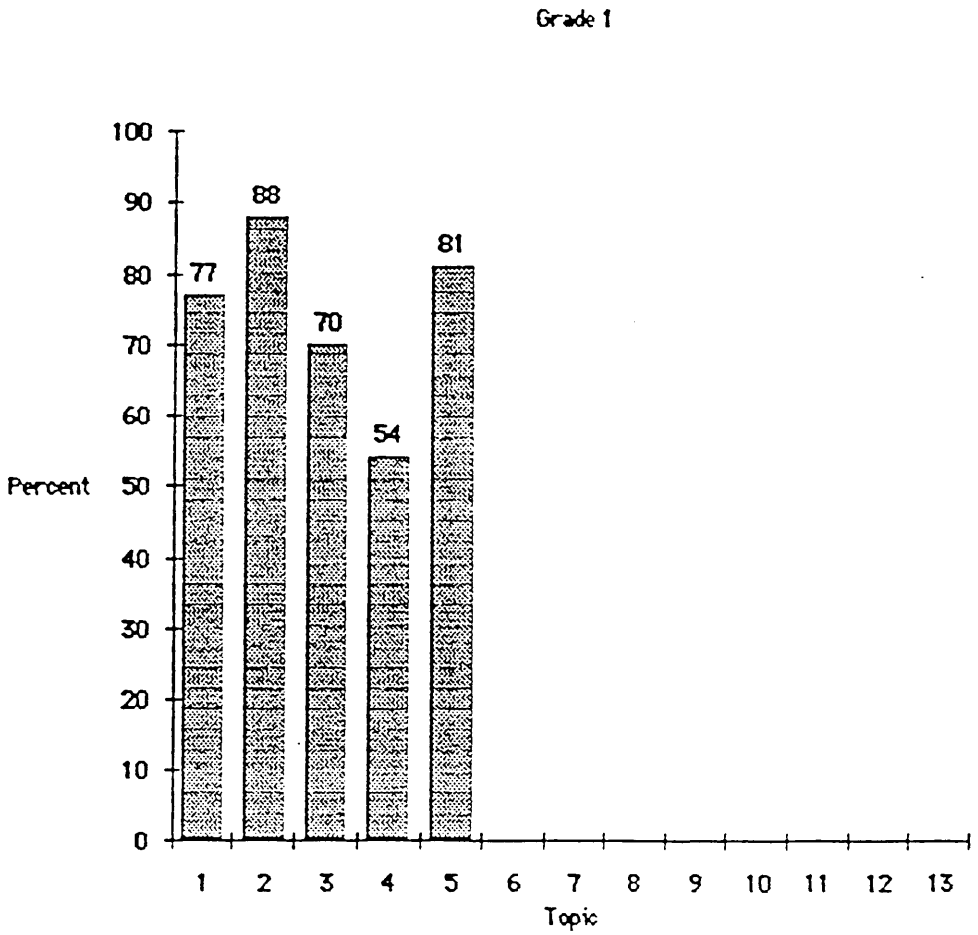
Third, Figure 3a reflects relatively alignment between curriculum objectives and the test items on number comparison. However, there are still some learning weaknesses deriving from instructional gaps: (a) misreading the ordinal number and (b) counting the number incorrectly.

From a psychometric perspective, the pattern of intercorrelations is consistent with the instructional pattern. Each topic correlates relatively and significantly high with total score; the range was between .63 in geometry and .76 in size and place relationship. Within topics, the correlation coefficients were considerably lower but significant. For example, the correlation coefficient between number recognition and number comparison was .38. The item (20 items) pool exhibits good structure as evidenced by KR20 reliability of .761.

Grade 2

Of the nine topics (number recognition, number comparison, measurement, geometry, basic addition/subtraction facts, addition/subtraction algorithm, basic multiplication facts, fraction recognition and problem solving) in this grade, three

Figure 3a. Graphical representation of the total student performance at grade 1 within mathematical topics.



skills (basic addition/subtraction facts, basic multiplication facts and fraction recognition) had the highest scores. However, some students did not learn the skills (see Figure 3b).

Weaknesses deriving from instructional gaps in basic addition/subtraction facts include: (a) making an error in the basic facts (e.g., one more/less than the correct answer), (b) failing to understand the meaning of the operation sign, (c) perceptual error of reversing the sum digit, (d) failing to understand the identify element zero (when it occur in the stem) e.g., choosing zero as the correct answer and (e) reversal of direction of subtraction--subtracting top number from the bottom number.

Weaknesses in fraction recognition deriving from instructional gaps include: (a) interchanging shaded and unshaded units, (b) making an error in counting the parts and (c) reversing the result of "less/greater than" symbols.

Weaknesses in basic multiplication facts deriving from instructional gaps include: (a) failing to interpret operation sign correctly (e.g., adding instead of multiplying) and (b) failing to understand multiplication facts by 2 as a factor (choosing "2" rather than the correct answer).

Performance on the number recognition, geometry and addition/subtraction algorithm was above the cutoff score.

Weaknesses in number recognition deriving from instructional gaps include: (a) error in counting an ordinal number by one less/more than the correct answer, (b) omitting place holder for ones or tens, (c) incorrectly including an ordinal number 2 before/after than the correct ordinal number and (d) reversing digits.

Weaknesses in geometry deriving from instructional gaps include: (a) choosing a shape does not match the designated word, (b) failing to rotate the figure and (c) an error in counting the sides of the figure (especially in item # 28).

Weaknesses in addition/subtraction algorithm items deriving from instructional gaps include: (a) making an error in basic facts, (b) failing to understand the algorithm, (c) failing to interpret operation sign (e.g., subtracting instead of adding) correctly and (d) reversing digit.

It is possible to relate the low performance to the instructional emphasis for all three topics. These three topics were aligned but not highly with curriculum objectives in the second grade.

The three topics with lowest means--number comparison, measurement and problem solving--did not align with curriculum objectives and textbook coverage of subskills at this grade.

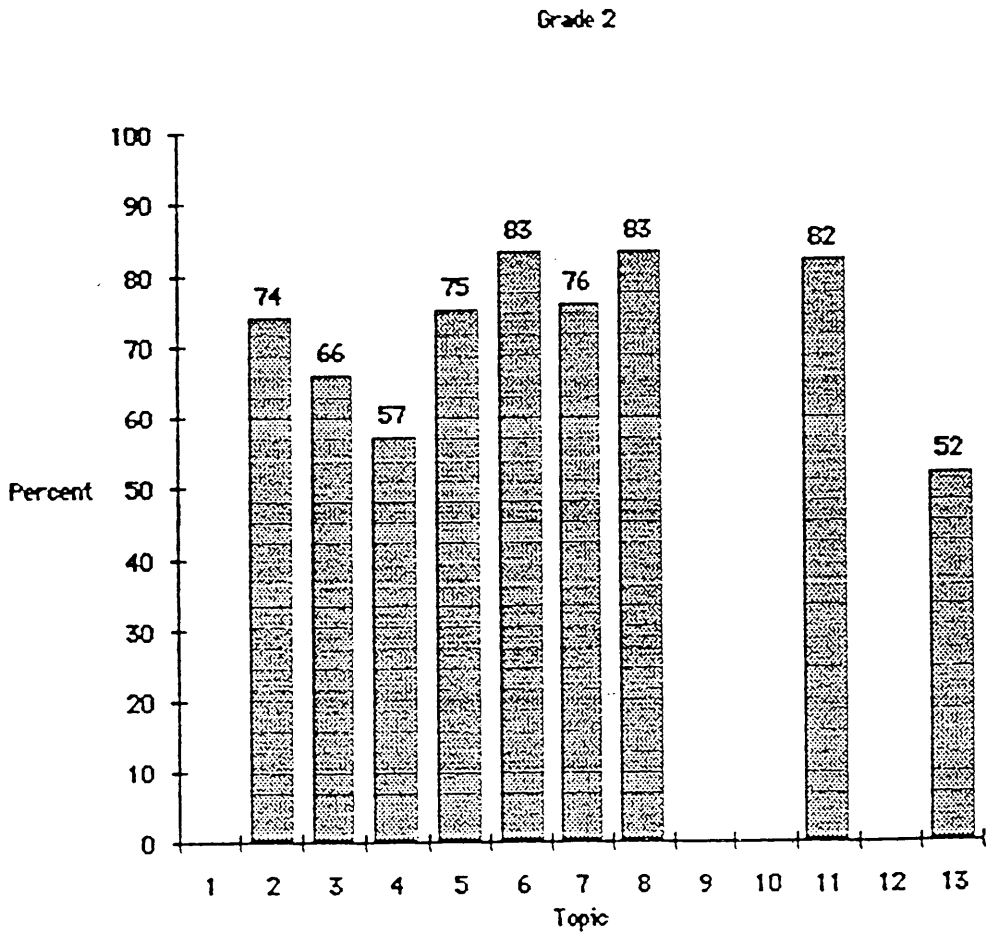
Number comparison weaknesses deriving from instructional gaps include: (a) miscounting in ordinal number than the correct answer, (b) reversing digits. and (c) misusing "=" or reversing the roles of "<" ">".

Measurement topic weaknesses deriving from instructional gaps include: (a) failing to identify coins correctly, (b) failing to add coins correctly, (c) making an error of quarter of hour, (d) misusing the incorrect dimension (e) making an error in 1 or 1/2 unit either direction and (f) starting measurement at one instead of zero.

Finally, problem solving weaknesses deriving from instructional gaps include: (a) failing to choose the correct operation and (b) making an error in the basic facts (e.g., one more/less than the correct answer).

From a psychometric perspective, each topic correlates relatively and significantly with total score; the range was between .40 in fraction recognition and .78 in basic addition/subtraction facts. Among topics, the correlation coefficients are considerably

Figure 3b. Graphical representation of the total student performance at grade 2 within mathematical topics.



lower but significant. The item (30 items) pool exhibits good structure as evidenced by KR20 reliability of .822.

Grade 3

Of the eleven topics (number recognition, number comparison, measurement, geometry, basic addition/subtraction facts, addition/subtraction algorithm, basic multiplication/division facts, multiplication/division algorithm fraction recognition and problem solving) in this grade, measurement, number comparison addition/subtraction algorithm, basic division facts, multiplication/division algorithm and problem solving skills had the lowest score.

Weaknesses in basic addition/subtraction facts deriving from instructional gaps include: (a) making an error in the basic facts (e.g., one more/less than the correct answer), (b) failing to understand the meaning of the operation sign, (c) reversing the sum digit, (d) failing to understand the identify element zero (when it occur in the stem); e.g., choosing zero as the correct answer and (e) reversing the direction of subtraction--subtracting top number from the bottom number.

Weaknesses in basic multiplication facts deriving from instructional gaps include: (a) failing to interpret operation sign correctly (e.g., adding instead

of multiplying) and (b) failing to understand multiplication facts by 2 as a factor (choosing "2" rather than the correct answer).

Weaknesses in fraction recognition deriving from instructional gaps include: (a) reversing numerator and denominators and (b) interchanging shaded and unshaded parts.

Weaknesses in basic division facts deriving form instructional gaps: (a) making an error in the basic facts (b) failing to interpret operation sign correctly (e.g., subtracting instead of dividing) and (c) failing to understand the meaning of division operation (e.g., moving the dividend and the divisor together, as in 0 - 6 = 60. rather than the correct answer).

Weaknesses in number recognition skill deriving from instructional gaps include: (a) miscounting an ordinal number by one less/more than the correct answer, (b) omitting place holder for ones or tens, (c) placing an ordinal number 2 before/after the correct ordinal number and (d) reversing digits.

Weaknesses in answering the geometry items deriving from instructional gaps include: (a) failing to distinguish between an angle and other geometrical shapes (like "S" shape) and (b) choosing a perpendicular lines instead of parallel lines.

Weaknesses in the addition/subtraction algorithm topic deriving from instructional gaps include: (a) making an error in basic facts, (b) failing to understand the algorithm, (c) failing to interpret operation sign (e.g., subtracting correct operation) and (d) making an error in the basic facts (e.g., one more/less than the correct answer).

Measurement weaknesses include: (a) failing to read words correctly, (b) making an error of quarter hour, (c) reversing numbers shown by hour and minutes and (d) confusing in weight notation (e.g., grams instead of kilograms).

Weaknesses in multiplication/division algorithm deriving from instructional gaps include: (a) making an error in the number of zero, (b) failing to interpret the operation sign correctly (adding instead of multiplying), (c) confusing the place value of partial products, (d) deriving an answer before operation was completed and (e) misinterpreting a remainder was interpreted wrongly.

Problem solving weaknesses deriving from instructional gaps include: (a) lacking reading skills or fundamental operation knowledge, (b) failing to choose the correct operation, (c) choosing a given number as an answer and (d) failing to rename correctly.

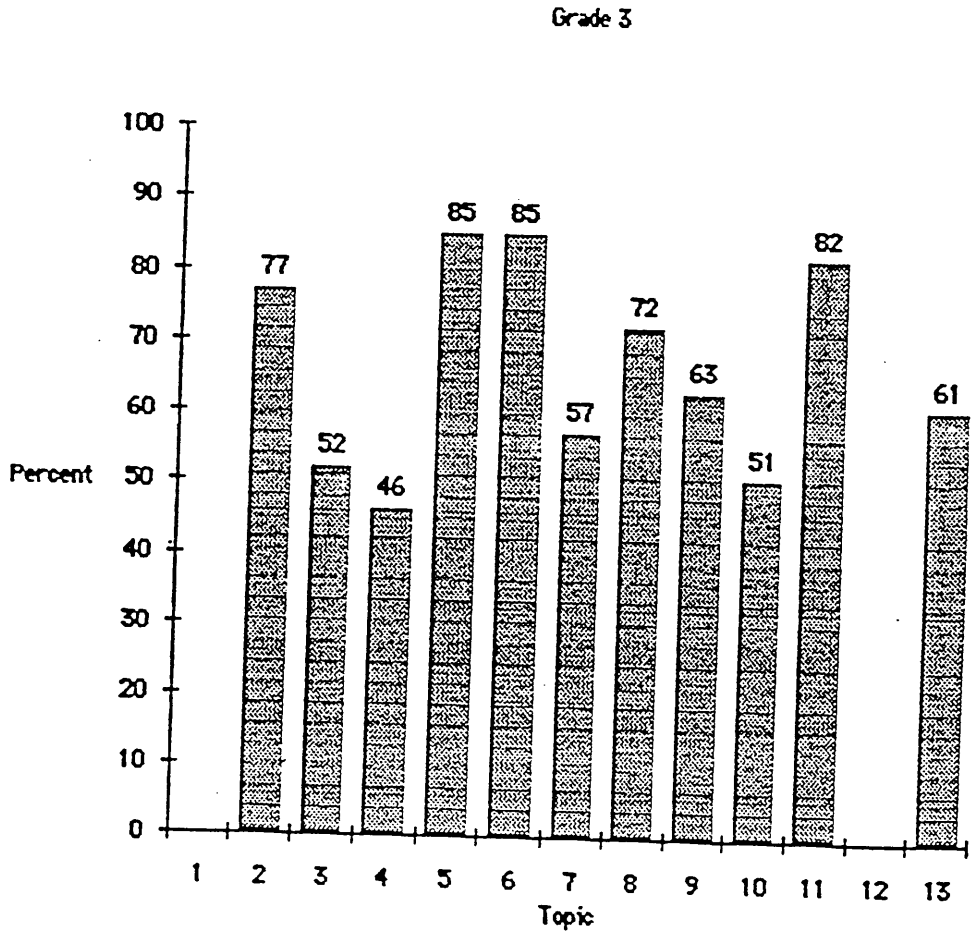
From a psychometric perspective, each topic correlates relatively and significantly with total score; the range was between .26 geometry and .71 problem solving. Among topics, the correlations were considerably lower but significant. For example, the correlation coefficient between number comparison and measurement was .47 and the correlation between geometry and fraction recognition was below .05. The item (30 items) pool exhibits good structure as evidenced by KR20 reliability of .828.

In sum, Figure 3c shows that five topics out of eleven were aligned with curriculum objectives at grade 3. However, five topics were misaligned with curriculum objectives. The misalignment reflects the following considerations: (a) old rather than the new curriculum curriculum was implemented, (b) the misaligned-skills get less instruction and practice than the aligned-skills, and (c) reliance on grade level in instructional materials (textbooks).

Grade 4

Of the twelve topics (number recognition, number comparison, measurement, geometry, basic addition/subtraction facts, addition/subtraction algorithm, basic multiplication/division facts, multiplication/division algorithm fraction recognition

Figure 3c. Graphical representation of the total student performance at grade 3 within mathematical topics.



around 50 percent and 2 topics means around 40 percent. Obviously these nine topics were highly misaligned with the curriculum objectives at this grade.

Weaknesses in number recognition skill deriving from instructional gaps include: (a) miscounting an ordinal number by one less/more than the correct answer, (b) omitting place holder for ones or tens, (c) placing an ordinal number 2 before/after the correct ordinal number and (d) reversing digits.

Weaknesses in number comparison deriving from instructional gaps include: (a) choosing equality instead of inequality and (b) misusing "=" or reversing the roles of "<" ">".

Basic addition/subtraction weaknesses deriving from instructional gaps include: (a) making an error in the basic facts (e.g., one more/less than the correct answer), (b) failing to understand the meaning of the operation sign, and (c) failing to use only the number listed in the family of facts.

Weaknesses in multiplication/division facts, deriving from instructional gaps include: (a) failing to interpret operation sign correctly (e.g., adding instead of multiplying) and (b) failing to use only the number listed in the family of facts equation.

Weaknesses in addition/subtraction algorithm topic deriving from instructional gaps include: (a) making an error in basic facts, (b) failing to understand the algorithm, (c) failing to interpret operation sign (e.g., subtracting instead of adding) correctly, (d) reversing digit, (e) failing to recognize that the addition and subtraction are inverse operations, (f) failing to reposition the numbers and (g) regrouping directly from hundreds to ones.

Weaknesses in measurement deriving from instructional gaps include: (a) failing to read words correctly, (b) making an error in basic facts, (c) misusing the incorrect dimension, (d) confusing in weight notation (e.g., grams instead of kilograms), (e) making an error in 1 or 1/2 unit either direction and (f) starting measurement at one instead of zero.

Multiplication/division algorithm weaknesses deriving from instructional gaps include: (a) making an error in the number of zero, (b) failing to interpret the operation sign correctly (adding instead of multiplying), (c) a place value of partial products was confused, (d) derived an answer before operation was completed, (e) a remainder was interpreted wrongly (f) failing to subtract correctly (g) for hundreds, the

child just add without multiplying first and (h) division from right to left.

Problem solving weaknesses deriving from instructional gaps include: (a) lacking complex mental processes, quantitative thinking, the ability to read and the amount of fundamental operation knowledge, (b) failing to choose the correct operation, (c) choosing a given number as an answer, (d) failing to rename correctly and (e) the rule of placing the decimal point in the differences is applied in a sum.

From a psychometric perspective, each topic correlates relatively and significantly with total score; the range was .41 in geometry and .63 in measurement. Within topics, the correlations coefficients were considerably lower but significant. For example, the correlation between basic addition/subtraction facts and basic multiplication facts was .39 and the correlation between geometry and addition/subtraction algorithm was below .05. The item (20 items) pool exhibits good structure as evidenced by KR20 reliability of .774.

In sum, Figure 3d shows that three topics out of twelve were aligned with curriculum objectives at grade 4. However, nine topics were misaligned with curriculum objectives. The misalignment includes the following

consideration: (a) the old rather than new curriculum was implemented, and (b) the misaligned-skills get less instruction and practice than the aligned-skills.

Association of Student Gender With Test Performance

To investigate the association of student gender differences with the test scores, a series of analyses of variance (ANOVA) was performed for each topic and total test score. The results are shown in Table 5.

The pattern of significant effects is shown in Figure 4a. The pattern is not easily interpreted. However, where differences occur, females tend to score higher than male, except at the third grade where the tendency is reversed. Where there are differences on the measurement topic, males consistently score higher than females. Where there are differences on the addition/subtraction algorithm and problem solving topics, females consistently score higher than males.

Association of Classroom Organizational Structure (Departmentalized VS. Self-Contained) With Test Performance at Grade 1-3

To investigate the association of classroom organizational structure with test score at grades 1-3, a series of analyses of variance was conducted

Figure 3d. Graphical representation of the total student performance at grade 4 within mathematical topics.

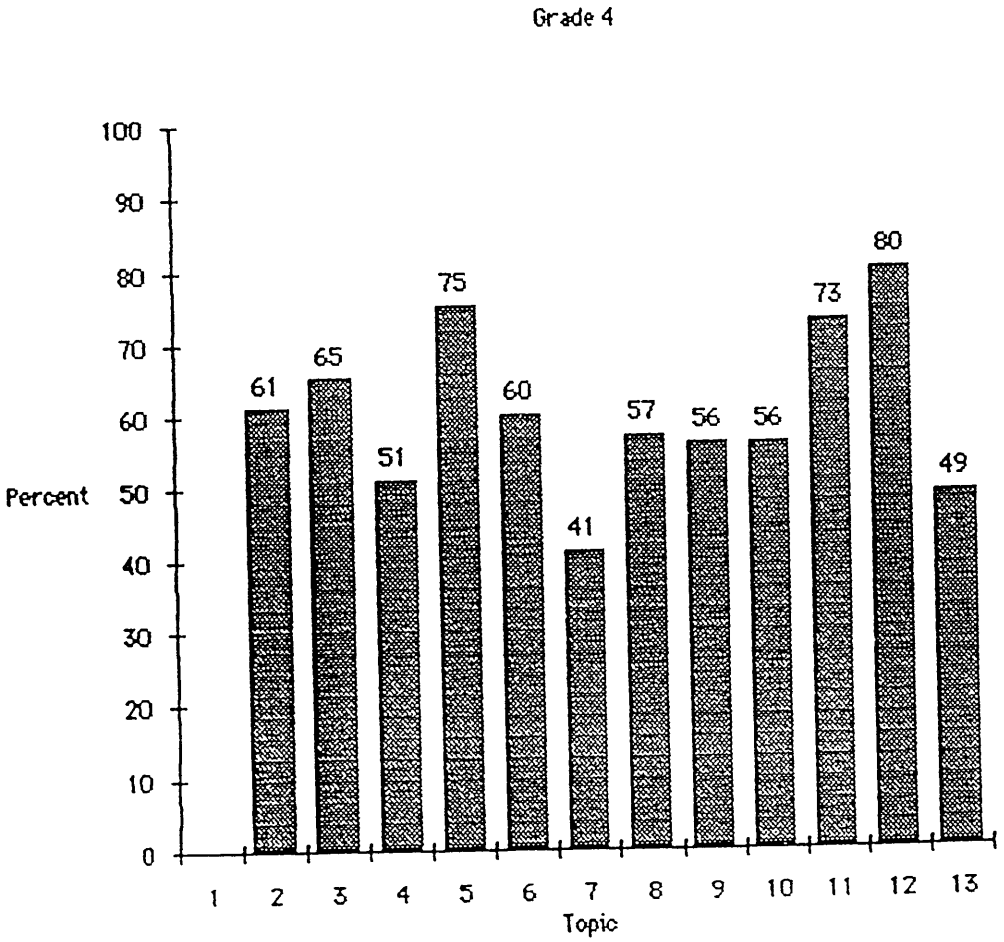


Table 5

Summary of ANOVA Results Within Grades Across Topics by Sex Factor (1-4)

Summary	Means		F-value	Probability
	Male	Female		
Mathematical Topics				
Grade 1				
	n=381	n=440		
T1[a]	6.12	6.22	01.54	NS
T2	2.51	2.75	20.53	.01
T3	2.72	2.91	06.05	.01
T4	1.06	1.10	00.31	NS
T5	2.23	2.60	34.20	.01
Total	14.70	15.57	16.41	.01
Grade 2				
	n=396	n=435		
T2	2.22	2.22	00.00	NS
T3	2.71	2.60	02.88	NS
T4	2.38	2.15	08.22	.01
T5	2.90	3.12	12.05	.01
T6	3.14	3.44	17.35	.01
T7	3.51	4.02	29.74	.01
T8	1.60	1.74	10.54	.01
T11	1.61	1.66	01.69	NS
T13	1.09	1.01	02.29	NS
Total	21.17	21.95	04.92	NS
Grade 3				
	n=398	n=431		
T2	1.55	1.52	00.37	NS
T3	1.83	1.31	65.92	.01
T4	1.69	1.11	74.79	.01
T5	1.73	1.66	60.00	.01
T6	3.35	3.43	01.22	NS
T7	1.06	1.23	09.76	.01
T8	1.43	1.44	00.10	NS

(Table 5 continued).

Summary Topics	Means		F-value	Probability
	Male	Female		
	n=398	n=431		
T9	1.34	1.20	07.57	.01
T10	1.75	1.34	37.38	.01
T11	2.54	2.41	06.86	.01
T13	2.61	2.29	15.89	.01
Total	20.90	18.94	27.79	.01
Grade 4				
	n=405	n=429		
T2	1.12	1.32	17.84	.01
T3	0.61	0.70	04.89	NS
T4	1.64	1.45	09.51	.01
T5	1.46	1.53	03.36	NS
T6	0.57	0.64	04.99	NS
T7	0.34	0.47	12.69	.01
T9	0.50	0.63	13.61	.01
T10	1.03	1.22	12.51	.01
T11	2.06	2.33	19.48	.01
T12	1.45	1.74	09.94	.01
T13	0.91	1.06	07.95	.01
Total	11.70	13.07	26.64	.01

Note. a: Topics (T): Place and size relationship (T1), Number recognition (T2), Number comparison (T3), Measurement (T4), Geometry (T5), Basic addition and subtraction facts (T6), Addition and subtraction algorithms (T7), Basic multiplication facts (T8), Basic division facts (T9), Multiplication and division algorithms (T10), Fraction recognition (T11), Fraction computation (T12), and Problem solving (T13).

Figure 4a. Association of student gender with test performance.

Mathematical Topics	Grades			
	1st grade	2nd grade	3rd grade	4th grade
Size and Place Relationship	F[a]			
Number Recognition	F			F
Number Comparison	F		M[b]	F
Measurement	M		M	M
Geometry	F	F	M	F
Addition/Subtraction Facts		F		F
Addition/Subtraction Algorithm		F	F	F
Multiplication Facts		F		F
Division Facts			M	F
Multiplication/Division Algorithm			M	F
Fraction Recognition			M	F
Fraction Computation				F
Problem Solving			F	F
Total	F	F	M	F

a: Female (F).
b: Male (M).

Table 6

Summary of ANOVA Results Within Grades Across Topics by Classroom Organizational Structure Factor (1-3)

Summary	Means		F-value	Probability
	Dept.[a]	SelfC.[b]		
Topics				
Grade 1				
	n=511	n=310		
T1	6.01	6.45	25.51	.01
T2	2.60	2.70	03.51	NS
T3	2.77	2.90	02.91	NS
T4	0.94	1.31	39.99	.01
T5	2.28	2.66	35.69	.01
Total	14.61	16.03	38.64	.01
Grade 2				
	n=729	n=102		
T2	2.20	2.35	01.04	NS
T3	2.69	2.89	07.31	.01
T4	2.21	2.55	08.09	.01
T5	2.98	3.24	06.77	.01
T6	3.27	3.47	03.35	NS
T7	3.73	4.10	06.50	.01
T8	1.64	1.82	07.20	.01
T11	1.65	1.54	02.89	NS
T13	1.01	1.28	12.03	.01
Total	21.34	23.27	13.03	.01
Grade 3				
	n=714	n=115		
T2	1.50	1.73	12.10	.01
T3	1.51	1.82	10.74	.01
T4	1.34	1.65	09.02	.01
T5	1.74	1.44	28.44	.01
T6	3.33	3.73	07.15	.01
T7	1.10	1.41	01.17	NS
T8	1.40	1.44	01.62	NS
T9	1.23	1.46	08.49	.01
T10	1.59	1.17	17.82	.01
T11	2.42	2.80	29.88	.01
T13	2.39	2.75	09.55	.01
Total	19.61	21.59	13.34	.01

a: Departmentalized (Dept.).
b: Self-contained (SelfC.) .

Figure 4b. Association of classroom organizational structure with test performance.

Mathematical Topics	Grades 1st grade	2nd grade	3rd grade
Size and Place Relationship	S[a]		
Number Recognition	S	S	S
Number Comparison	S	S	S
Measurement	S	S	S
Geometry	S	S	D[b]
Addition/Subtraction Facts		S	S
Addition/Subtraction Algorithm		S	S
Multiplication Facts		S	S
Division Facts			S
Multiplication/Division Algorithm			D
Fraction Recognition			S
Fraction Computation			
Problem Solving			S
Total	S	S	S

a: Departmentalized (D).
b: Self-contained (S).

for each topic and total score. The result is shown in Table 6. There was no analysis for grade 4 due to unequal sample, (grade, 801 in departmentalized to 33 in a self-contained).

The pattern of significant effects is shown in Figure 4b. Where differences occur, self-contained classroom organization students tend to score higher than departmentalized classroom students. The reason may related to a more focused instructional emphasis in self-contained classrooms.

Association of Student Gender With Test Performance at Grade Levels Within Four Schools

To further investigate the association and interaction of student gender and classroom organizational structure with test performance a subsample of schools was selected to provide a balanced sample for the analysis. This sample constituted four schools: Self-contained classes/female students, self-contained classes/male students, departmentalized classes/female students, and departmentalized classes/male students. This sample provided a basis for investigating both main and simple effects and interactions of the two factors for all topics and total score at grade 1 through 4.

To investigate the association of student gender differences on the test scores within the four selected schools, a series of analyses of variance (ANOVA) was performed for each topics and total test score. The results are shown in Table 7.

The pattern of significant effects is shown in Figure 4c. The pattern is not easily interpreted. However, where differences occur, females tend to score higher than male, except at the third grade where the tendency is reversed. Where there are differences on the measurement topic, males consistently score higher than females. Where there are differences on the addition/subtraction facts topic, females consistently score higher than males.

Association of Classroom Organizational (Departmentalized VS. Self-Contained) With Test Performance at Grades Levels Within Four Schools

To investigate the association of classroom organizational with test score at grade, a series of analyses of variance (ANOVA) was conducted for each topic and total score. The result is shown in Table 8.

The pattern of significant effects is shown in Figure 4d. The pattern is not easily interpreted. However,

Table 7

Summary of ANOVA Results Within Grades Across Topics by Sex Factor (1-4) Within Four Schools

Summary Mathematical Topics	Means		F-value	Probability
	Male	Female		
Grade 1				
	n=62	n=69		
T1[a]	5.97	6.68	12.30	.01
T2	2.52	2.78	05.23	.01
T3	2.74	3.29	11.99	.01
T4	0.95	1.62	39.55	.01
T5	2.29	2.80	17.56	.01
Total	14.97	16.92	30.30	.01
Grade 2				
	n=62	n=67		
T2	2.44	2.06	06.31	.01
T3	2.71	2.60	00.32	NS
T4	2.82	2.04	17.67	.01
T5	2.84	3.27	06.38	.01
T6	3.11	3.33	01.37	NS
T7	3.55	3.81	00.98	NS
T8	1.71	1.75	00.12	NS
T11	1.76	1.72	00.20	NS
T13	0.89	1.18	00.63	NS
Total	21.82	21.55	00.09	NS
Grade 3				
	n=64	n=67		
T2	1.81	1.73	16.08	.01
T3	1.61	1.15	10.62	.01
T4	1.23	0.88	08.64	.01
T5	1.87	1.88	00.08	NS
T6	3.56	3.51	00.08	NS
T7	1.15	1.45	06.06	.01
T8	1.45	1.35	00.11	NS
T9	1.20	1.10	02.19	NS
T10	0.70	0.75	00.35	NS

(Table 7 continued).

Summary	Means		F-value	Probability
	Male	Female		
Mathematical Topics				
T11	2.80	2.60	04.50	NS
T13	2.73	2.00	14.54	.01
Total	19.94	18.58	04.33	.01
Grade 4				
	n=72	n=69		
T2	0.93	1.48	08.90	.01
T3	0.53	0.65	00.08	NS
T4	1.43	1.94	00.00	NS
T5	1.29	1.74	05.30	.01
T6	0.36	0.72	10.26	.01
T7	0.29	0.51	00.02	NS
T8	0.37	0.61	03.26	NS
T9	0.37	0.61	03.26	NS
T10	1.07	1.13	05.81	.01
T11	2.08	2.45	00.24	NS
T12	1.33	1.75	04.09	NS
T13	0.46	1.09	00.26	NS
Total	10.15	14.07	02.60	NS

Note. a: Topics (T): Palce and size relationship (T1), Number recognition (T2), Number comparison (T3), Measurement (T4), Geometry (T5), Basic addition and subtraction facts (T6), Addition and subtraction algorithms (T7), Basic multiplication facts (T8), Basic division facts (T9), Multiplication and division algorithms (T10), Fraction recognition (T11), Fraction computation (T12), and Problem solving (T13).

Figure 4c. Association of student gender with test performance within four schools.

	Grades			
	1st grade	2nd grade	3rd grade	4th grade
Mathematical Topics				
Size and Place Relationship	F[a]			
Number Recognition	F	M	M	F
Number Comparison	F		M[b]	F
Measurement	F	M	M	
Geometry	F	F		F
Addition/Subtraction Facts			F	
Addition/Subtraction Algorithm				F
Multiplication Facts				F
Division Facts				F
Multiplication/Division Algorithm				F
Fraction Recognition			M	
Fraction Computation			M	
Problem Solving			M	
Total	F		M	F

a: Female (F).
b: Male (M).

where differences occur, self-contained students tend to score higher than departmentalized within all grade levels.

Interaction between Students Gender and Classroom Organizational Structure

To investigate the manner in which departmental and self-contained class organization may differentially effect the test performance boys and girls, the results for the four schools representing each of these classification categories were subjected to a series of analyses of variance for each topic at each grade.

As can be noted in Table 9, for the most part there were no significant interactions. The significant interactions which were identified are graphed in Figures 5a-k.

At grade 1, the interaction appears to result from lower performance of males in departmentalized classes (See Figures 5a-c).

At grade 2, the interaction reflects the same relationship but for females rather males (See Figure 5d).

At grade 3, there is a tendency for better male performance in departmentalized than in self-contained

Table 8

Summary of ANOVA Results Within Grades Across Topics by Classroom Organizational Structure Within Four Schools

Summary	Means		F-value	Probability
	Dept.[a]	SelfC.[b]		
Mathematical Topics				
Grade 1				
	n=69	n=62		
T1	5.97	6.76	14.85	.01
T2	2.51	2.82	07.22	.01
T3	2.93	3.29	01.97	NS
T4	1.16	1.47	08.92	.01
T5	2.41	2.73	07.27	.01
Total	14.97	16.92	16.13	.01
Grade 2				
	n=72	n=57		
T2	2.19	2.30	00.51	NS
T3	2.53	2.81	01.90	NS
T4	1.97	2.98	29.08	.01
T5	3.08	3.04	00.10	NS
T6	3.18	3.28	00.28	NS
T7	3.44	3.98	04.42	.01
T8	1.71	1.75	00.12	NS
T11	1.75	1.72	04.42	NS
T13	0.75	1.18	12.91	.01
Total	20.61	23.04	05.87	.01
Grade 3				
	n=67	n=64		
T2	1.81	1.73	01.32	NS
T3	1.10	1.66	14.86	.01
T4	1.01	1.09	00.58	NS
T5	1.88	1.87	00.01	NS
T6	3.43	3.64	02.59	NS
T7	1.30	1.30	00.40	NS
T8	1.30	1.50	02.37	NS
T9	1.45	1.20	00.90	NS
T10	0.90	0.55	11.59	.01

(Table 8 Continued).

Summary	Means		F-value	Probability
	Dept.[a]	SelfC.[b]		
Mathematical Topics[c]				
T11	2.60	2.80	03.31	NS
T13	2.73	2.00	04.71	.01
Total	18.57	19.95	04.51	.01
Grade 4				
	n=108	n=34		
T2	1.05	1.70	09.31	.01
T3	0.54	0.76	02.95	NS
T4	1.43	2.52	25.45	.01
T5	1.29	1.74	13.33	.01
T6	0.46	0.79	01.60	NS
T7	0.29	0.76	19.43	.01
T8	0.44	0.67	00.89	NS
T9	0.44	0.67	00.89	NS
T10	0.94	1.61	24.63	.01
T11	2.11	2.76	08.77	.01
T12	1.34	1.76	06.29	.01
T13	0.48	1.70	52.54	.01
Total	10.52	17.15	53.93	.01

a: Departmentalized (Dept.).
b: Self-contained (SelfC.).
Note. c: Topics (T): Palce and size relationship (T1), Number recognition (T2), Number comparison (T3), Measurement (T4), Geometry (T5), Basic addition and subtraction facts (T6), Addition and subtraction algorithms (T7), Basic multiplication facts (T8), Basic division facts (T9), Multiplication and division algorithms (T10), Fraction recognition (T11), Fraction computation (T12), and Problem solving (T13).

Figure 4d. Association of classroom organizational structure with test performance within four schools.

	Grades			
	1st grade	2nd grade	3rd grade	4th grade
Mathematical Topics				
Size and Place Relationship	S[a]			
Number Recognition	S			S
Number Comparison		S	S	
Measurement	S	S		S
Geometry	S			
Addition/Subtraction Facts				
Addition/Subtraction Algorithm		S		S
Multiplication Facts				
Division Facts				
Multiplication/Division Algorithm			D[b]	S
Fraction Recognition		D	S	S
Fraction Computation				S
Problem Solving		S		S
Total	S	S	S	S

a: Self-contained (S).
b: Departmentalized (D).

classes with the reverse holding for females (See Figures 5e-k).

Taken in sum, the interactions appear to stem from the instructional and personal characteristics of the individual teachers involved in the analysis rather than from student gender or classroom organizational characteristics as such.

Discussion

The discussion is organized in terms of the questions addressed by the study. First question addresses is: Are there empirical gaps in student performance on tests that suggest inadequate textbook coverage? The major differences between the present study textbook coverage and the other studies (e.g., Driscoll, 1981; Floden et al., 1981; Freeman et al, 1983; Kuhs & Freeman, 1979; Law, 1982; Scott, 1983) is that in Bahrain elementary grades most subskills are not covered in the textbooks while the topics are varied in their coverage within the textbooks.

Kuhs and Freeman (1979) analyzed three widely used fourth-grade textbooks--Addison-Wesley, Hooghton-Mifflin, and Scott-Foresman. The researchers first compiled a list of all the mathematics topics covered in these texts. A comparison of the texts disclosed that

Table 9
Summary of ANOVA Results Within Grades Across Topics by Classroom Organization and Sex Factors Interaction

Summary	Cell Means				F-value	Probaility
	M-[a] Self.	F-[b] Dept.	M-Dept.	F-Self.		
Topics						
Grade 1						
	n=30	n=37	n=32	n=32		
T1	6.83	6.68	5.16	6.69	15.98	.01
T2	2.77	2.70	2.28	2.88	1.72	NS
T3	3.00	3.30	2.50	3.28	2.49	NS
T4	1.23	1.57	0.69	1.69	3.89	.01
T5	2.80	2.41	2.29	2.73	0.35	NS
Total	16.33	16.92	12.72	17.47	9.41	.01
Grade 2						
	n=27	n=37	n=35	n=30		
T2	2.52	2.03	2.37	2.10	0.06	NS
T3	2.74	2.38	2.69	2.87	1.13	NS
T4	3.00	1.30	2.69	2.97	12.81	.01
T5	2.89	3.35	2.80	3.17	0.64	NS
T6	3.11	3.24	3.11	3.43	0.28	NS
T7	3.74	3.49	3.40	4.20	0.53	NS
T8	1.70	1.70	1.71	1.80	0.20	NS
T11	1.81	1.78	1.71	1.63	1.81	NS
T13	1.15	0.81	0.69	1.20	0.96	NS
Total	22.67	20.08	21.17	23.37	0.80	NS
Grade 3						
	n=30	n=33	n=34	n=34		
T2	1.50	1.85	1.74	1.94	4.27	.01
T3	1.87	0.82	1.38	1.47	0.32	NS
T4	1.03	0.61	1.41	1.15	14.29	.01
T5	1.83	1.85	1.91	1.91	1.17	NS
T6	3.53	3.27	3.59	3.74	3.91	.01
T7	0.90	1.20	1.40	1.70	17.60	.01
T8	1.50	1.20	1.40	1.50	00.70	NS
T9	0.90	0.70	1.50	1.50	1.80	NS
T10	0.10	0.50	1.30	1.00	82.88	.01
T11	2.90	2.50	2.70	2.70	0.21	NS
T13	2.70	1.55	2.79	2.44	05.94	.01
Total	18.67	16.00	21.06	21.09	30.36	.01

a: Male-departmentalized. b: Female-self-contained.

Figure 5a. Mean scores for male-self-contained and female-departmentalized on the T1 at grade 1.

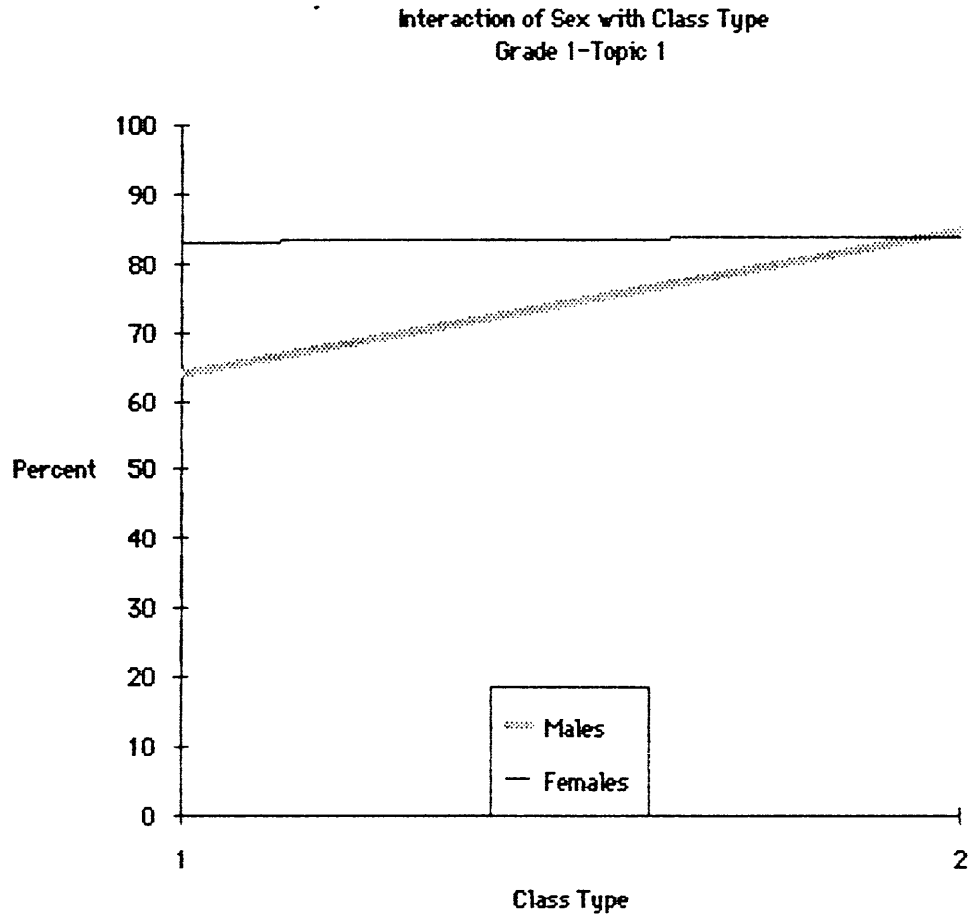


Figure 5b. Mean scores for male-self-contained and female-departmentalized on the T4 at grade 1.

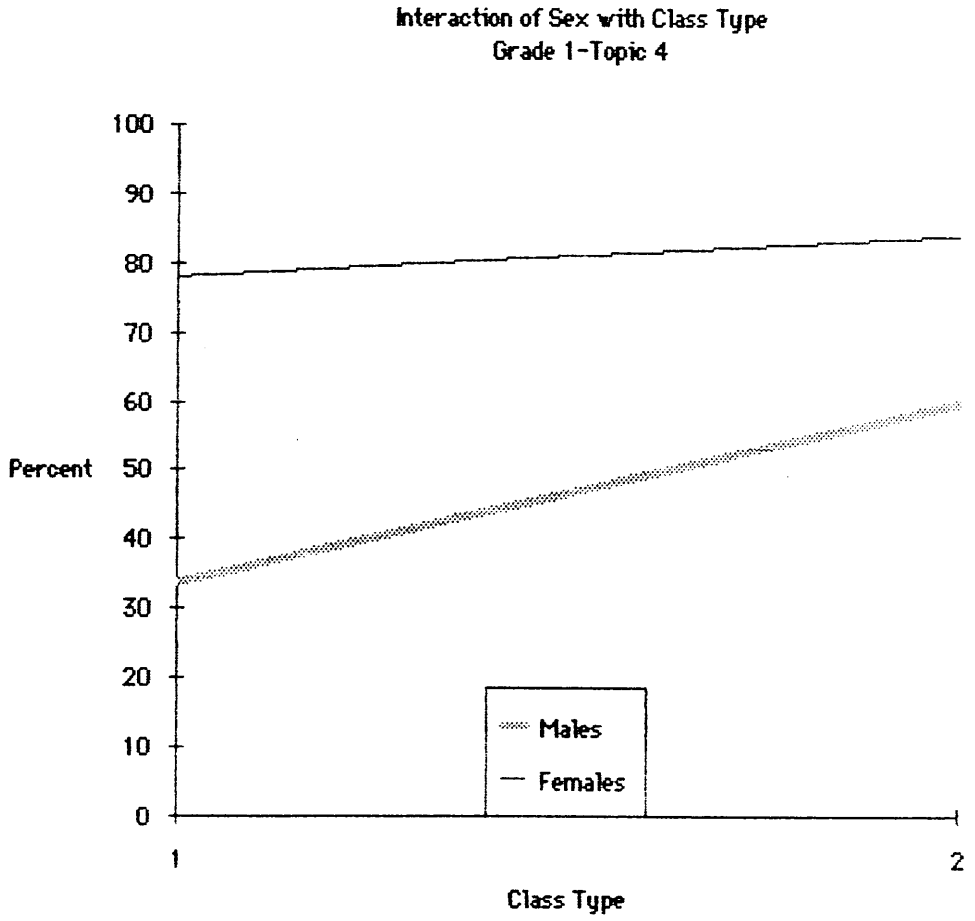


Figure 5c. Mean scores for male-self-contained and female-departmentalized on the total score at grade 1.

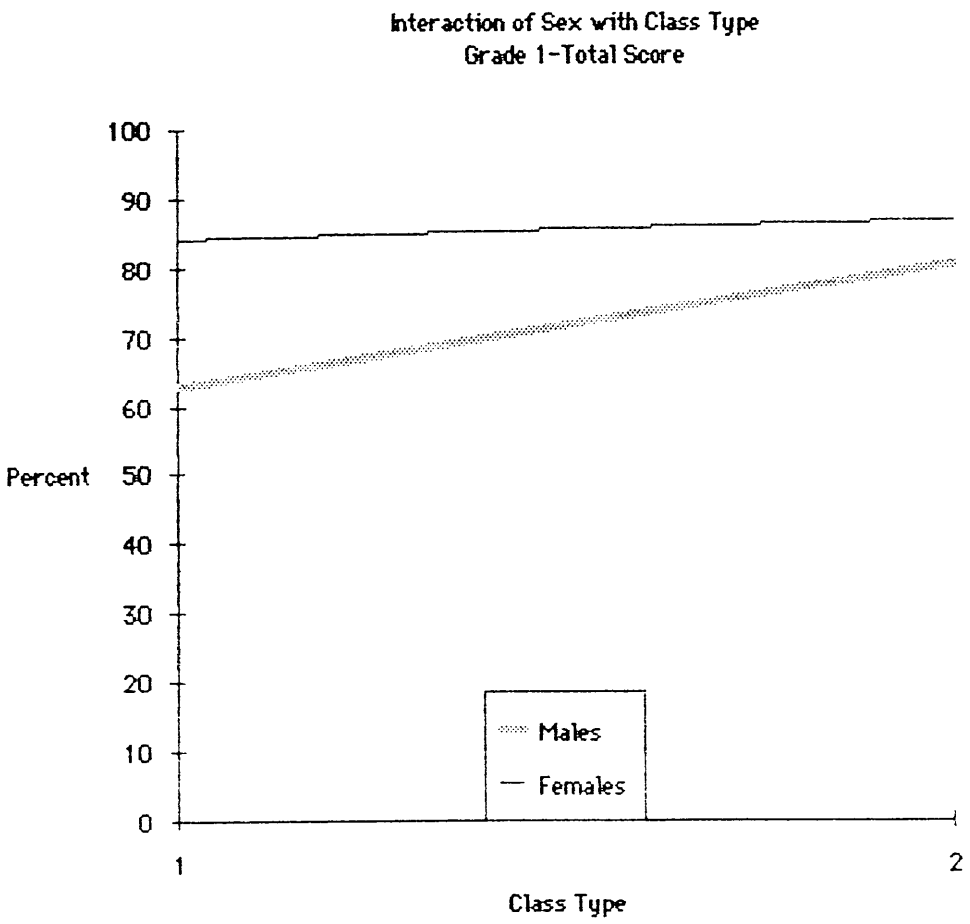


Figure 5d. Mean scores for male-self-contained and female-departmentalized on the T4 at grade 2.

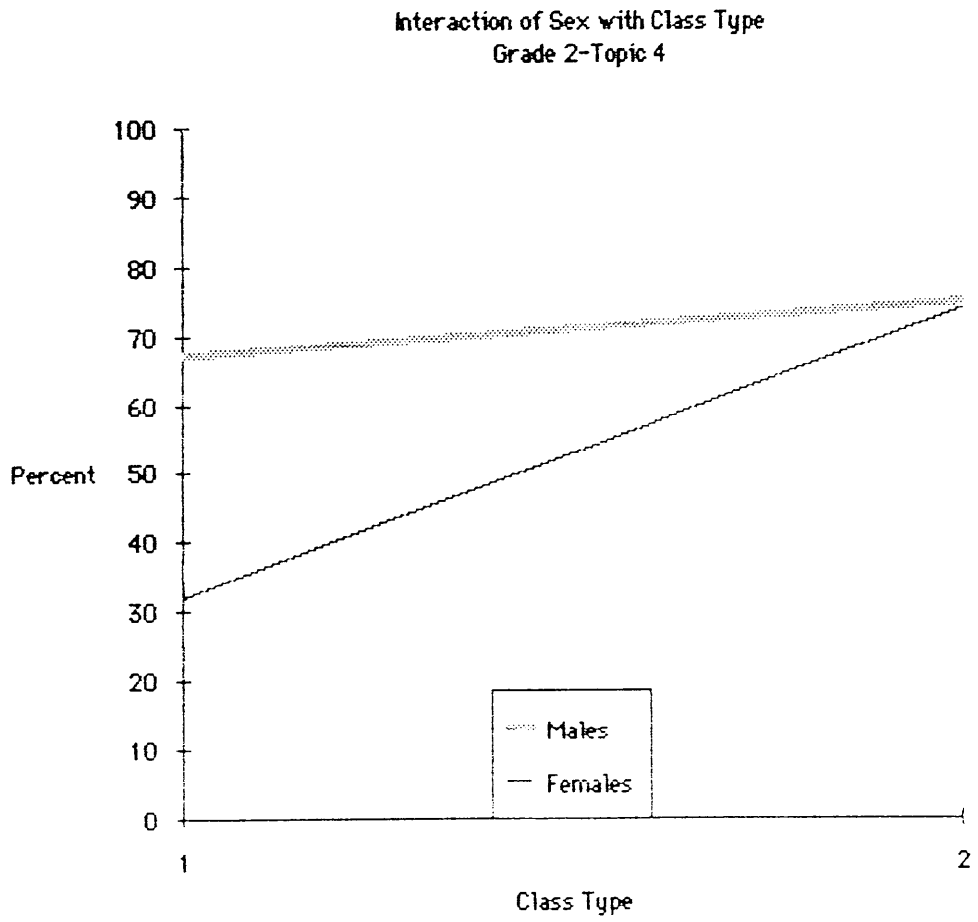


Figure 5e. Mean scores for male-self-contained and female-departmentalized on the T2 at grade 3.

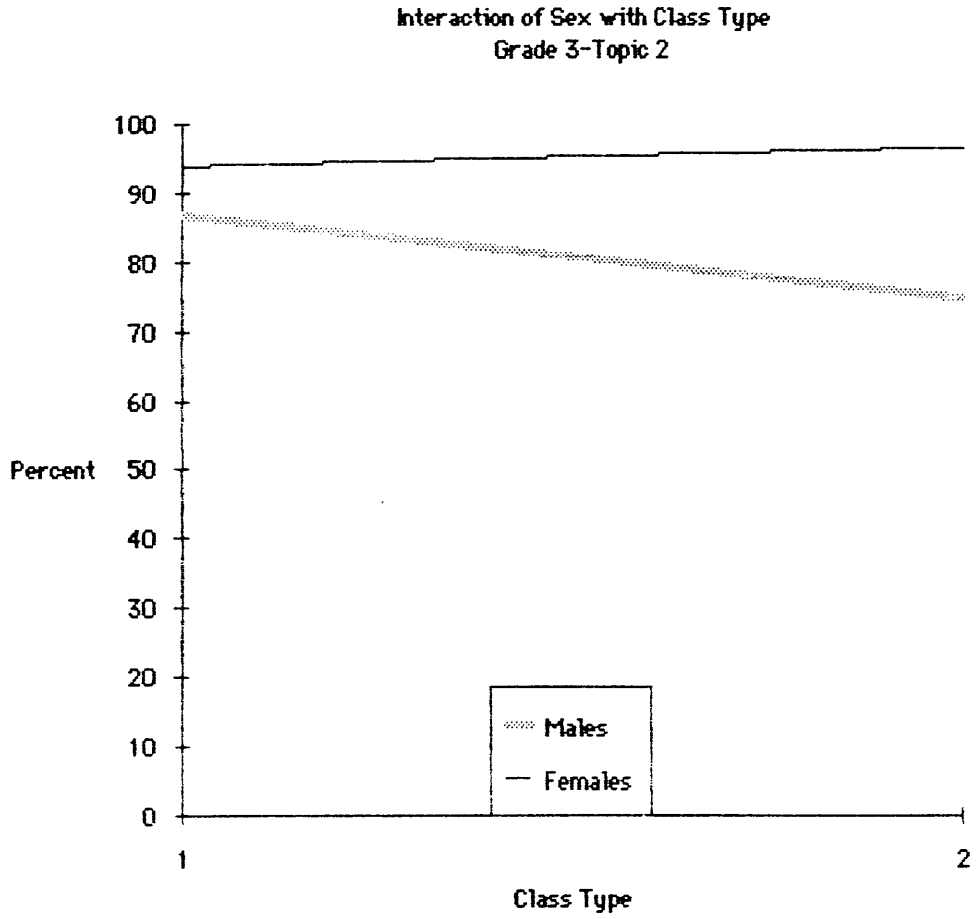


Figure 5f. Mean scores for male-self-contained and female-departmentalized on the T4 at grade 3.

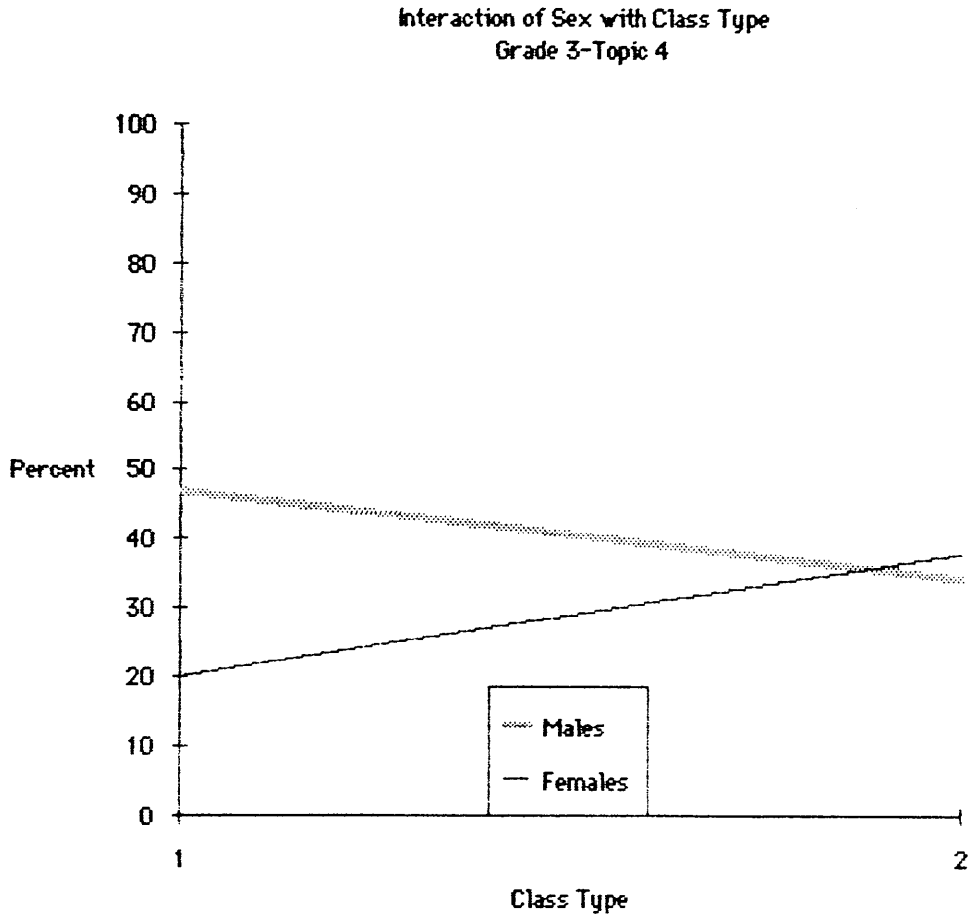


Figure 5g. Mean scores for male-self-contained and female-departmentalized on the T6 at Grade 3.

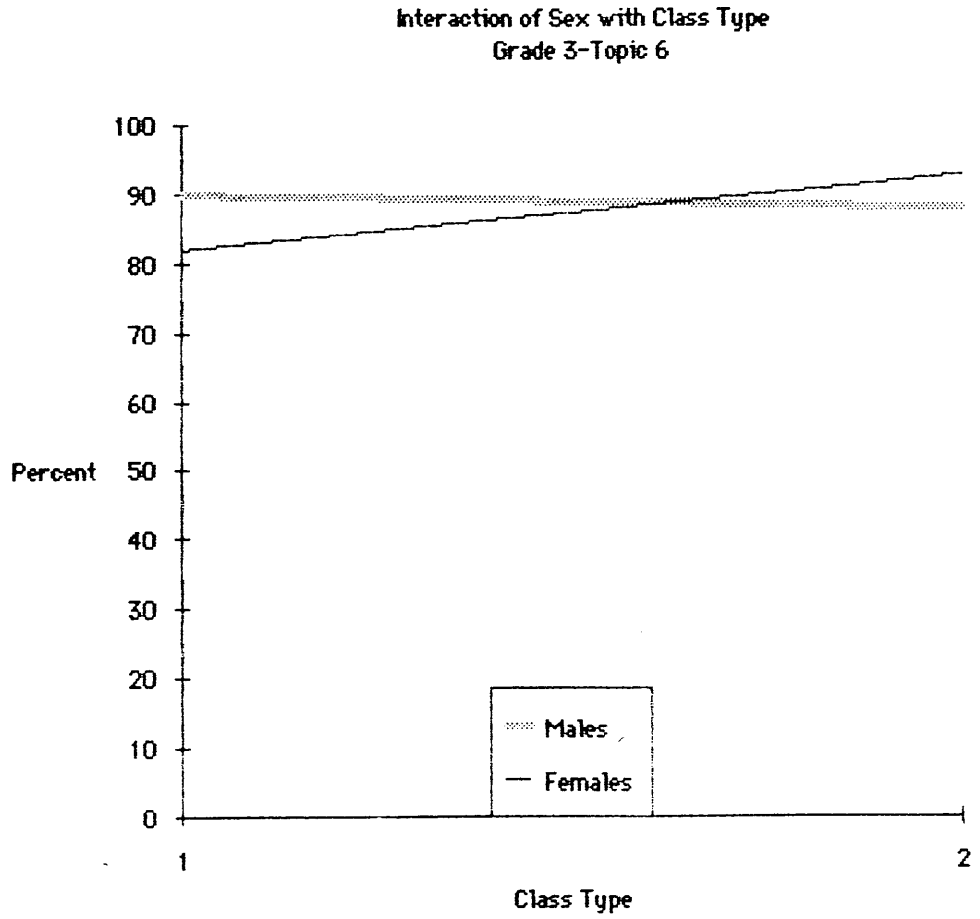


Figure 5h. Mean scores for male-self-contained and female-departmentalized on the T7 at grade 3.

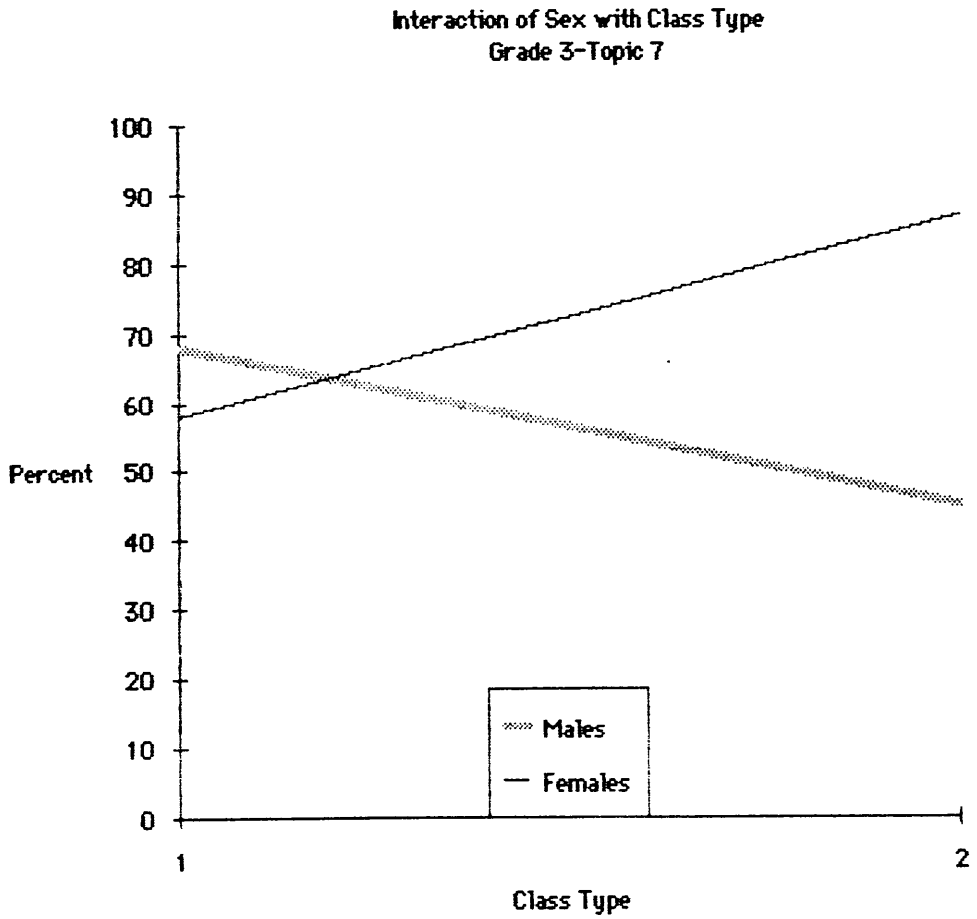


Figure 5i. Mean scores for male-self-contained and female-departmentalized on the T10 at grade 3.

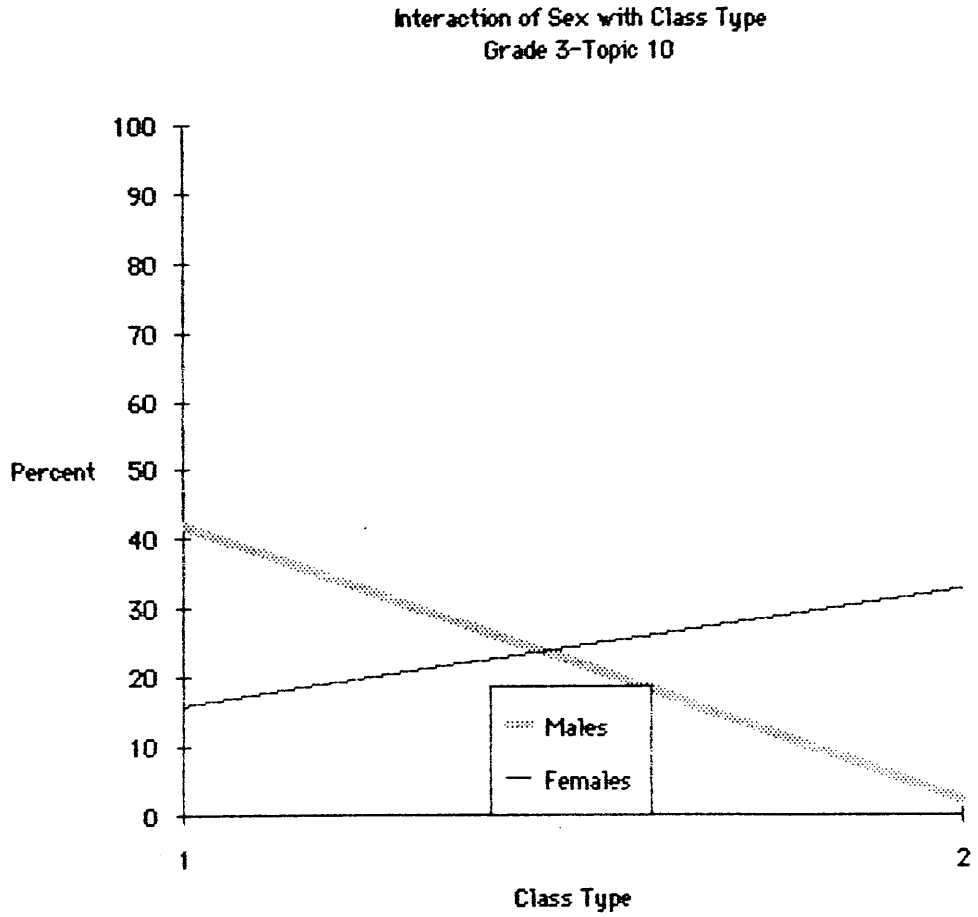


Figure 5j. Mean scores for male-self-contained and female-departmentalized on the T13 at grade 3.

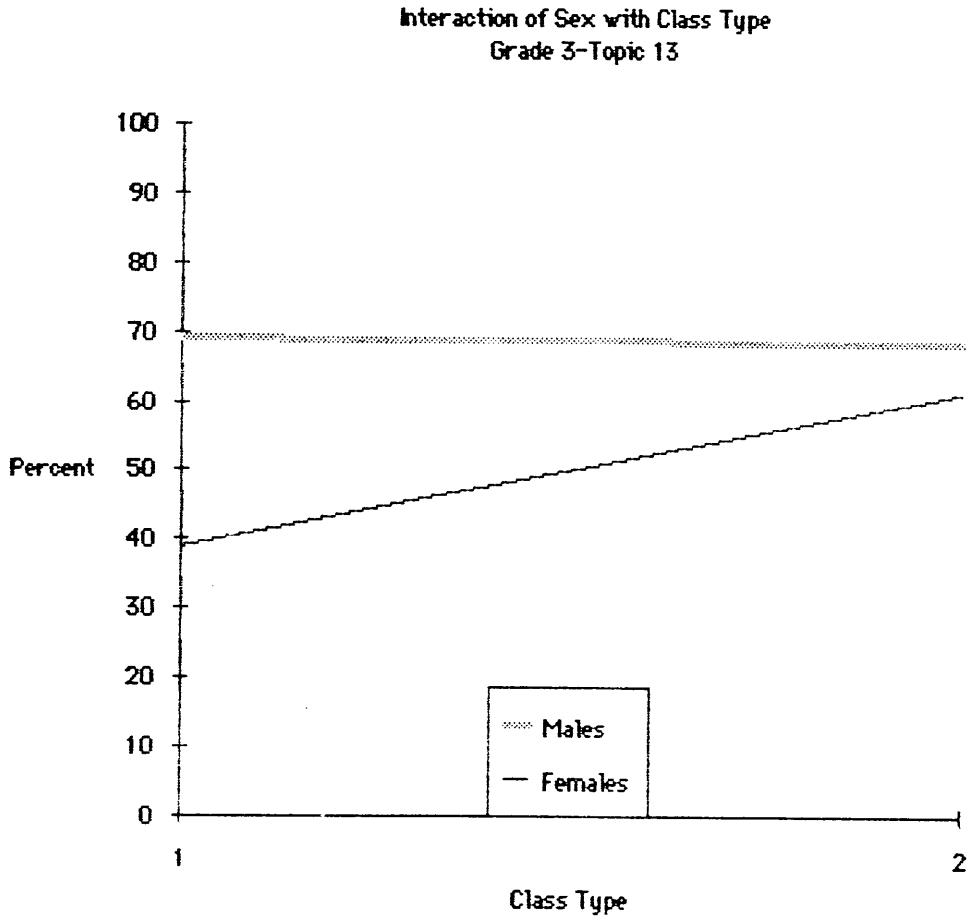
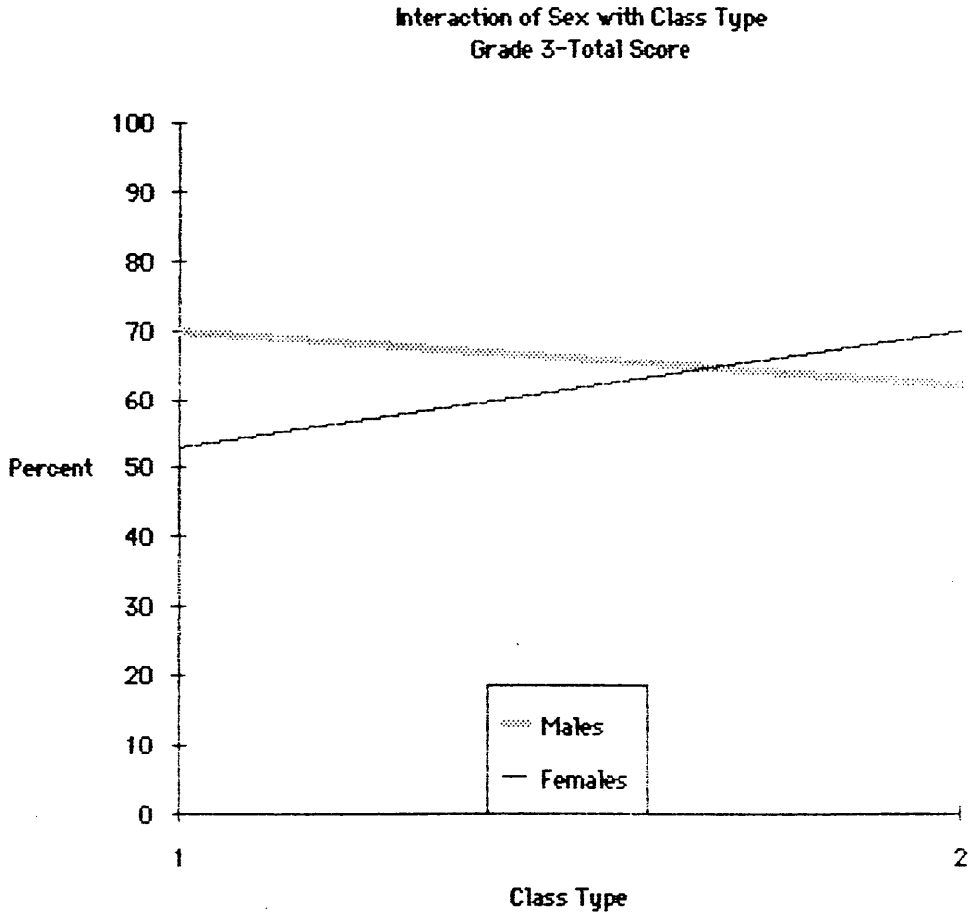


Figure 5k. Mean scores for male-self-contained and female-departmentalized on the total score at grade 3.



more than half of the topics on this list are covered in only one of the three texts. For example, estimating the fractional parts of pictorial models appears only in Addison-Wesley. In addition, they also found that for many topics covered in all three texts, emphases vary considerably among the three textbooks.

Another question of the present study is the pattern of student performance within and across school grades. The results of this study indicate that the first-graders were learning well the overall designated mathematical topics (76 percent). These findings are consistent with Karner (1977) and others (Buchanan, 1982; Buchanan et al., 1983; Hudson, 1983). For example, the present study shows that the children in this grade respond to some subskills (e.g., more/less) 90 percent correctly. This is consistent with the the results of Karner's (1977) study. However, other subskills involving place and size in the present study (e.g., right/left position or direction) are not attained by most students in this grade (average correct responses were 40 percent). This also harmonizes with Karner's findings within this subskill (56 percent). Perhaps for both studies this may reflect the instructional emphasis on these subskills that the children received.

The test data related to counting concepts (subskill: count 1-10) indicates that children responded above 85 percent correctly (informally or formally). Similar finding were found in Hudson's (1983) study and in Baroody (1984, 1987) inquiry where his subject at age 7 responded 100 percent correctly.

Results of the present study on the geometry concept within grade 1 exhibit that children responded over 85 percent correctly (recognize shape of triangle and circle). Karner's (1977) study is in agreement with the present finding where 80 percent of his subjects responded correctly to the recognition of the same two concepts. Burger (1985) and Cox (1985) pointed out that some students may have difficulty with the incomplete notions of simple geometric shapes. This also is consistent with the present study where 15 percent of the subjects have not learned these two subskills.

Instructionally, in general, these studies suggest that deficiencies in learning these subskills can be attributed to the instructional emphasis the children received. For example Baroody (1984), Burger (1985), Driscoll (1981), and Hudson (1983) pointed out that instructional planning for the first graders should: (a) emphasize the counting strategies slowly and carefully, (b) use an informal and formal approaches to cultivate

numeration skills, and (c) refer to visual prototype to characterized geometrical shapes.

At grades 2-4 the present study found that 28 percent, 34 percent, and 38 percent of the total sample in grade 2, 3 and 4 respectively, did not learn well the mathematical skills that are assessed in these grades. These findings relate to several determinants that were found or hypothesized in other research (Baroody, 1987; Driscoll, 1981; Saxe, 1979). For example, Saxe (1979) found that quantitative counting strategies develop prior to the development of number concept. Moreover, Baroody (1987) and Driscoll (1981) pointed out that counting from 20 is an especially difficult skill and is typically not mastered before the beginning of the third grade. This counting difficulty was found in the present study, for example, at second grade within the subskill (which number is missing; item # 6) where the average correct responses 69 percent of the total sample of the student. Similar correct responses were found in the third grade (61 percent; item # 3).

In addition, researchers who have studied counting in the elementary schools (e.g., Baroody, 1984, 1987; Driscoll, 1981; Ginsburg, 1983; Wood et al., 1975) have identified six main stages of counting: Rote counting, point counting, ordinal counting, counting-on, counting-

back and counting-on and counting-back directly. In these stages children have difficulty getting two skills started at the same time, for example. Baroody (1987) stated that children appear to learn the first number-sequence by rote counting--at this stage the child has learned number words and recite a counting sequence. The greater/less than subskill notation (<, >) was assessed in the present study at grade (2 and 4). It was found in this study that this subskill was not well-learned in either grades 2 or 4. Students responded 52 percent and 65 percent respectively. Research has clearly demonstrated that the difficulty in this subskill is that the children are not able to compare larger numbers according to their understanding of the place value system of numeration (Hudson, 1983). For example, Baroody (1984) suggested that children are accustomed to treating multidigit numerals, such as 10, 70, 100, 300, as undifferentiated wholes: ten units, not 1 ten and 0 ones; seventy units, not 7 tens and 0 ones, and so forth.

An understanding of the place-value concept is needed before children can understand addition and subtraction with regrouping (borrowing and carrying), and for children to comprehend place-value, they need knowledge of numeration and number concepts. In

addition, because the numbers represented in a multidigit numeral must sum to the quantity represented by the whole numeral, children have to be able to understand part-whole numerical relations (Poss, 1986; Cited in Marshall & Smith, 1987; p. 373).

As discussed earlier at grade 1, student performance on the geometry concept was high. Similar performance was found at grades 2-4. However, there are several subskills related to this concept that the students did not accomplish. In grade 2, students responded 41 percent correctly on recognizing similar shapes, and in grade 4, students responded 57 percent correctly in recognizing perpendicular features of pair of lines. These findings are consistent with Burger's (1985) suggestion that students continually misuse terms such as similar shapes or perpendicular lines.

Usiskin (1982) has reported that some students fail to demonstrate some geometrical skills (recognition,, analysis and ordering). These students cannot identify such common geometric figures as squares, triangles, rectangles, or circles. Furthermore, Usiskins's study suggests that students have not begun to see relationships and build hierarchies in geometric figures. However, the students understand that a square

is a rectangle and a parallelogram and that both of these are examples of quadrilaterals.

Allardice and Ginsburg (1983) pointed out that children should learn the procedural rules for multidigit computation and renaming with understanding the underlying place-value rationale for such rules. However, the gaps between procedural rules and place-value understanding leads to difficulties such as: (1) alignment difficulties consist of incorrect or inconsistent positioning of digits, (2) systematic errors result from incorrect, partially correct, or invented underlying rationale for an algorithm, and (3) inconsistencies include using a procedure correctly on one occasion but not others. These indications are consistent with the present study findings. For example, there were systematic errors in the basic facts and in the algorithm computational procedures represented in the test items across grade levels (2-4). Moreover, an intensive body of research acknowledges these difficulties across cultural settings (e.g., Ashlock, 1982; Baroody, 1987; Brown & Burton, 1978; Cox, 1975; Kilian, 1980; Mckillip, 1981; Underhill et al., 1980; Roberts, 1969).

Solving verbally stated problems is one of the major weaknesses in children's mathematics achievement

(NAEP, 1979; Cited in Carpenter, 1980b; p. 52). The difficulty for many students appears to stem more from a lack of computational skills than from an inability to comprehend the problems (Brown & Burton, 1978; Marshall, 1984; Zweng, 1979).

The results of this study at grades 2-4 show that most children performed very low in the problem solving topic (52%, 61% and 49% across grades 2-4, respectively). This finding is consistent with other studies (Bruni, 1982; Lesh et al, 1983; Schoenfeld, 1987; Spencer & Lester, 1981). For example, Bruni (1982) and Spencer and Lester (1981) suggested that many primary grade children were on the average learning the missing addend problems, and many of them may not receive enough instruction in this topic in their classroom work.

Association of Sex Differences With Student Performance at Elementary School Mathematics

The effect of the student gender in this study are not consistent. Marshall and Smith (1987) reported a longitudinal study of elementary school mathematics performance over a 3-year periods. They examined the children's mathematics performance on assessment tests Survey of Basic Skills (SBS) given in the third and sixth grades. The test items fall in six categories:

(a) Computation problems, (b) counting problems, (c) visual problems, (d) geometry/measurement problems, (e) traditional word problems and (f) nontraditional word problems. They contrasted successful performance on six categories of items by sex and by grade. They also evaluated unsuccessful performance by means of analyses of errors and individual problems. They found that girls exhibit an advantage at third grade which disappears by sixth grade, and consistent sex-related errors were observed at both grades. The finding of this study are in harmony with Marshall and Smith (1987) regarding gender effect on students achievement. This study shows some sex influences on mathematical concepts. However, some topics result in very large differences, and others have very small differences at each grade level. In the first and second grade, girls' performance is better than boys on 78 percent of the test. At grade 3, boys' performance is better than girls' performance. Finally, at grade 4, both sexes performed lower, but the girls performance was better than boys. First, in basic addition/subtraction facts females outperform males at the second and third grades. This high performance of girls (86 percent correct responses for girls in both grades, and 79 percent and 84 percent for boys) disappears where both boys and

girls performed low. Second, for fraction recognition, girls consistently outperformed boys across grade levels. It will be noted that this high performance of girls may be related to the sample size or to cohort differences.

Association of Classroom Organizational Structure With Student Performance at Elementary school Mathematics

Classroom organizational structure has been the subject of much discussion (Cleavinger, 1968; Slavin, 1987a, 1987b; Ward, 1970). For example, Cleavinger's (1968) findings are in agreement with the present study. He found a significant difference in favor self-contained classrooms over departmentalized classrooms for arithmetic application (computational skills with problem solving). In addition, Ward (1970) found that students at grades 4-6 learned science significantly better in self-contained than in departmentalized classes; there were no significant differences in mathematics and social social studies.

The results of this study regarding the classroom organizational structure on children's performance across grade levels (1-3) show that children in self-contained classes performed higher on most tested topics than children in departmentalized classes. However, in

grade 3 some topics have small differences favoring children in departmentalized classes.

Both self-contained and departmentalized organization differentially affect the test performance of boys and girls in this study. In grade 1, the interaction appears to result from lower performance of male departmentalized classes. At grade 2, the interaction reflects the same relationship but for female rather than males. Finally at grade 3, there was a tendency for better male performance in departmentalized than in self-contained classes with reverse holding for females. Informal observation of classroom interactions suggests the possibility of important effects due to an uncontrolled teacher perference variable. However, in addition to the teacher variable, other unidentified factors may be contributing to these differences.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter summarizes the methodological procedures, and results of the study. Second, it presents conclusions that can be derived from the study. Finally, recommendations are represented.

Summary

The problem of the study was to determine: (a) the alignment of curriculum, instruction, objectives and assessment in mathematics in Bahrain elementary schools (grade 1-4), (b) student test performance across grade levels by topics related to the development of assessment instrument that is accurately reflected the alignment of instructional transaction and curriculum objectives, (c) the student test performance in term of major and specific instructional gaps, (d) association of student gender and classroom organizational structure on test performance across grade levels by topics and (e) the interaction between student gender and classroom organizational structure on test performance across grade levels by topics.

Research Methodology

Methodological procedures were as follows:

(1) Completing a correlation framework of mathematics curriculum statements through specification tables.

(2) Planning, designing and constructing assessment instruments sampling the key mathematical concepts on a grade-by-grade basis. Each of the tests included a representative number of test items (100 items for the four grade levels at Bahrain elementary schools), accompanied by a miniquestionnare regarding the characteristics of the sample involved in this study.

(3) Administering the tests to 3,316 children in the first four grades enrolled in 24 elementary schools at Bahrain, including all children in 12 schools for boys and same number for girls.

(4) Analyzing the reliability of the four test forms. Kuder-Richardson # 20 reliability was found to .76, .82, .82, and .77 for the designated forms respectively. Pearson-Product-Moment coefficients ranging from .05 to .70 were obtained for inter-item and inter-topic correlations.

(5) The scores of the children were evaluated through: Mean percentage of correct/incorrect responses to the test items, a series of analyses of variance.

Results of The Study

The findings are discussed in terms of the corresponding research questions of the study. The questions were: (1) Are there empirical gaps in student performance that suggest inadequate textbook coverage? (2) Are there differential patterns of performance associated with student gender, (3) Does teacher-classroom organizational structure differentially influence student performance and (4) Is there a significant interaction between gender and classroom organization across mathematical topics and across school grades?

Figure 2 exhibited the map of curriculum objectives by mathematical topic and grade levels. The alignment degree varied from adequately aligned, partially aligned and misaligned curriculum topics and textbook coverage. At grade 1 of the nine topics, three topics were adequately aligned while one topic was partially aligned and five topics were misaligned. At grade 2, of the ten topics, five topics were aligned, while three topics were partially aligned and two topics were misaligned. At grade 3, of the ten topics, three topics were aligned, three topics partially aligned and four topics were misaligned. Finally, at grade 4, of the twelve topics, five were aligned, one topic was

partially aligned and six topics were misaligned. Moreover, at both grades 3 and 4 there was no coverage for the basic computational facts (addition, subtraction, multiplication and division).

An examination of student test performance across grades levels by topics shows several patterns of student achievement. The overall mean percentage of student performance ranged from high in the first two grades (76 percent and 72 percent in grade 1 and grade 2 respectively) to low in the remaining two grades (66 percent in grade 3 and 62 percent in grade 4 respectively). The decreasing overall averages reflect several considerations.

First, Table 4 exhibited that 24 percent, 28 percent, 34 percent, and 38 percent of the total student sample in the first four grades respectively did not attain well in the mathematical skills that were assessed in these grades. These percentages intimated major learning problems that the total sample faced involving the subskills related to each assessed topic. At grade 2, some subskills related to the matching relationship received inadequate instructional attention; for example, recognizing the matching relations for size or position. In counting, recognizing the number and numeral in order received inadequate

instructional attention. Similar findings regarding inadequate instructional emphases were observed for geometry and order relation.

Second, at the upper grade levels, Table 4 exhibited that 28 percent, 34 percent and 38 percent of the total student sample did not perform well in the mathematical skills assessed in these grades. This low student performance was related to inadequate instructional attention to: Counting, geometry, and computational skills.

Third, the patterns of performance reflected instructional gaps. The number recognition topic, for example, uses the same label across grade levels but has different unrelated or semi-related meaning at different grades. Similar gaps were observed in the remaining topics: Number comparison, measurement, and geometry. Moreover, major instructional gaps were identified across grades (2-4) for more complex skills: Basic addition/subtraction facts, addition/subtraction algorithms, basic multiplication facts, basic division facts, multiplication/division algorithm, fraction computation and word problem solving. These gaps were reflected in the student performance ranging from low to high performance. The pattern indicates the desirability of strengthening the instruction or

otherwise modifying the curriculum relative to these topics.

Fourth, specific instructional gaps within grades by topics were investigated (See Figure 3 a-d). Analysis at grade 1 revealed weaknesses deriving from instructional gaps such as: Failing to identify coins correctly (measurement), failing to chose a shape that matches the designated shape in the stem of the question (geometry), and misreading the ordinal number. At grades 2-4, students exhibited weaknesses deriving from instructional gaps such as: Making an error in basic computational facts, failing to understand the meaning of the operation sign in algorithm operations, error in counting an ordinal number in number recognition comparison, reversing number shown by hour and minutes.

Fifth, the association of student gender with test performance was investigated by a series of analyses of variance. The study showed that females tend to score higher than males, except at the third grade where the tendency is reversed. For the addition/subtraction algorithm and problem solving topics, females consistently score higher than males.

Finally, the association of classroom organizational structure with test performance was investigated by a series of analyses of variance. Where

significant effect occur, self-contained classroom organization students scored higher than departmentalized students. For both factors (student gender and classroom organizational structure), the reason for the higher scores of female and self-contained classroom students appeared related to instructional emphases. In addition, the interaction of the two factors (sex and classroom organizational structure) was as follows:

1. At grade 1, the interaction appeared to result from lower performance of males in departmentalized classes.

2. At grade 2, the interaction reflected a relationship similar to grade 1, but for females rather than males.

3. At grade 3, there was a tendency for higher male performance in departmentalized than in self-contained classes with the reverse holding for females.

Conclusions

This study demonstrates the applicability of a new comprehensive instructional information system in the Bahrain educational system. First, the incorporation of the advantages of a comprehensive assessment model with curriculum alignment technology constitutes a crucial

stage in the maturation of the educational assessment in Bahrain. Second, it provides a means of aligning objectives, instruction and assessment. Third, it provides a means of insuring instruction that provides a systematic development of student skills in mathematics within and across grades by determining gaps that are reflected in the instructional materials and procedures. Fourth, it provides a means on identifying instructional strengths within and across schools so that the educational system may be regularly improved over time. Finally, the study provides that classroom organizational structure regarding gender differences across grade levels by topics increased instructional emphasis in terms of teacher perferences via self-contained classroom organizational structure.

Recommendations

Based on the findings of the study, several recommendations may be drawn:

1. A comprehensive instructional information system is an essential and useful phase of any instructional and assessment programs in Bahrain elementary schools. But to make this system play a positive and effective role in Bahrain elementary school, there is an urgent need to develop a much

broader collection of measurement techniques and instruments and to align these evaluation tools appropriately to the varied purposes of instructional planning.

2. In light of this study, there is a clear and urgent need for Bahrain educators to conduct research and development in testing and instruction in the Bahrain elementary school curricula--a major focus of the research and development should be on the components of curriculum alignment technology and the technical framework of this study.

3. The study provides foundation for generating tests (criterion-, or norm-referenced) for the yet-be-developed Bahrain Survey of Essential Skills which can be used to compare the performance of students throughout the country on an item-by-item or topic-by-topic basis, instead of the "cycle-, and teacher-made" tests presently used to promote of students from one grade to the next.

4. Additional work will be required to train teachers in making better classroom tests--tests should be used to identify children who are not learning, to diagnose their special learning difficulties, and to direct additional resources and individualized attention to them as early and as often as needed.

5. Additional research is needed to further account for possible alignment between instructional variables and individual teacher differences regarding classroom organizational structure.

BIBLIOGRAPHY

Allardice, B. S., & Ginsburg, H. P. (1983). Children's learning problems in mathematics. In H. P. Ginsburg (Ed.), The development of mathematics thinking (pp. 319-349). NY: Academic Press.

American Educational Research Association, American Psychological Association, & National Council on Measurement in Education; (Joint Committee). (1985). Standards for educational and psychological testing. Washington, DC: American Psychological Association.

Anderson, R. C. (1962). The case for teacher specialization in elementary schools. Elementary School Journal, 62(3), 253-260.

Anderson, R. E., Welch, W. W., & Harris, L. J. (1982). Methodological considerations in the development of indicators of achievement in data from the national assessment. Journal of Educational Measurement, 19(2), 113-124.

Araisian, P. W. (1987). State mandated testing and educational reform: Content and consequences. American Journal of Education, 4(3), 393-412.

Araisian, P. W., & Madaus, G. F. (1983). Linking testing and instruction: Policy issues. Journal of Educational Measurement, 20(2), 103-18.

Ashlock, R. B. (1972). Error patterns in computation. Columbus, Ohio: Cahrles E. Merrill.

Ashlock, R. B. (1982). Error patterns in computation: A semi-programmed approach. Columbus, Ohio: Cahrles E. Merrill.

Baker, R. L. (1974). Measurement consideration in instructional products development. Professional Paper # 29. (Los Alamitos, CA: SWRL Educational Research and Development).

Baker, R. L., & Hanson, R. (1981). Common sense approach to domain definition. Session 17A: Practical issues in assessing content valdity. Boston, MA: NCME.

Baker, R. L., & Schutz, R. E. (Eds.). (1971). Instructional products development. NY: Van Nostrand Reinhold.

Baroody, A. J. (1984). Children's difficulties in subtraction: Some causes and cores. Arithmetic Teacher, 32(3), 14-19.

Baroody, A. J. (1987). Children's mathematical thinking: A developmental framework for preschool, primary, and special education teachers. NY: Teachers College, Columbia University.

Benbow, C. P., & Stanley, J. C. (1980). Sex differences in mathematical ability: Facts and artifacts. Science, 210(10), 1262-1264.

Berk, R. A. (1980). Criterion-referenced measurement: The state of art. Baltimore, MD: Johns Hopkins University Press.

Berliner, D. C. (1980). Allocated time, engaged time, and academic learning time in elementary mathematics instruction. Focus on Learning Problems in Mathematics, 2(1), 27-39.

Bloom, B. J. (Ed.). (1956). Taxonomy of educational objectives. NY: Longmans.

Bock, R. D., Mislevy, R., & Woodson, C. (1982). The next stage in educational assessment. Educational Researchers, 11(3), 4-11.

Boli, J., Allen, M., & Payne, A. (1985). High ability men and women in undergraduate mathematics and chemistry courses. American Educational Research Journal, 22(4), 605-626.

Bookman, A. B., & Iwanicki, E. F. (1983). The effects of method of test preparation on standardized mathematics achievement test performance. Journal of Research and Development in Education, 16(4), 46-51.

Brown, J. S., & Burton, R. R. (1978). Diagnostic models for procedural bugs in basic mathematical skills. Cognitive Science, 2(1), 155-192.

Brulle, A. R., & Brulle, C. G. (1982). Basic computational facts: A problem and procedure. Arithmetic Teacher, 29(7), 34-36.

Bruner, J. S. (1966). Toward a theory of instruction. Cambridge, Mass.: Harvard University Press.

Bruni, J. V. (1982). Problem solving for the primary grades. Arithmetic Teacher, 29(6), 10-15.

Buchanan, A. (1982). The shape of learning opportunity in school arithmetic and general mathematics. Technical Report No. 80. (Los Alamitos, CA: SWRL Educational Research and Development).

Buchanan, A. (1984). Avoiding pitfalls in the pursuit of higher standards for elementary schooling. Technical Report No. 87. (Los Alamitos, CA: SWRL Educational Research and Development).

Buchanan, A., Schutz, R. E., & Milazzo, P. (1983). Instructional risk reduction: An alternative to instructional remediation. Technical Report No. 81. (Los Alamitos, CA: SWRL Educational Research and Development).

Burger, W. F. (1985). Geometry. Arithmetic Teacher, 32(6), 52-56.

Buros, O. K. (1977). Fifty years in testing: Some reminiscences, criticisms, and suggestions. Educational Researcher, 6(1), 9-15.

California State Department of Education. (1979). Test content specifications for the survey of basic skills: Mathematics grade 3. Sacramento, CA: California State Department of Education.

Carpenter, T. P., Kapner, H., Corbit, M. K., Lindquist, M. M., & Reys, R. E. (1980a). Results and implications of the second NAEP mathematics assessment: Elementary school. Arithmetic Teacher, 27(8), 10-12, 44-47.

———— (1980b). Students effective responses to mathematics: Results and implications from national assessment. Arithmetic Teacher, 28(2), 34-37, 52-53.

Case, D. A. (1971). A comparative study of fifth graders in a new middle school with fifth graders in elementary self-contained classrooms. Dissertation Abstract International, 32, 86A. (University Microfilms No. 71-16, 770).

Chall, J. (1977). An analysis of textbooks in relation to declining SAT scores. Princeton: College Entrance Examination Board.

Check, N. H., & Castle, K. (1981). The effect of back-to-basic on mathematics education. Contemporary Educational Psychology, 6(3), 263-277.

Cleavinger, A. E. (1968). The study of two types of elementary school organization in grades five and six. (Unpublished Doctoral Dissertation). University of Kansas. Dissertation Abstract International, 29, 2055A-2056A.

Cooley, W. W., & Leinhardt, G. (1980). The instructional dimensions study. Educational Evaluation and Policy Analysis, 2(1), 7-25.

Coordinator's Guide for Staff Development Activities: Curriculum Alignment Project (1982-82). Los Alamitos, CA: SWRL Educational Research and Development and LAUSD.

Cox, L. S. (1975). Systematic errors in the four vertical algorithms in normal and handicapped populations. Journal for Research in Mathematics Education, 6(8), 31-48.

Cox, P. L. (1985). Informal geometry: More is needed. Mathematics Teacher, 78(6), 404-405.

Cronbach, L. J. (1963). Course improvement through evaluation. Teacher's College Record, 64(4), 672-683.

Cronbach, L. J. (1971). Test validation. In R. L. Thorndike (Ed.), Educational measurement (pp. 443-507). Washington, DC: American Council on Education.

Denmark, T., & Kapner, H. S. (1980). Basic skills in mathematics: A survey. Journal for Research in Mathematics Education, 11(2), 104-123.

Driscoll, J. M. (1981). Research within reach: Elementary school mathematics. Natinal Counsel of Teachers of Mathematics. VA: Natinal Institute of Education.

Duncan, E. R., Capps, L. R., Dolciani, M. P., Quast, W. G., & Zweng, M. (1967a). Modern school mathematics: Structure and use. Boston: Houghton Mifflin Co.

———————. (1967b). Modern school mathematics: Structure and use. Boston: Houghton Mifflin Co.

Durkin, D. (1978-79). What classroom observations reveal about reading comprehension instruction. Reading Research Quarterly, 14(4), 481-533.

Eccles, J. S. (1984). Sex differences in mathematics participations. In M. Sreinkamp & M. Maehr (Eds.), Women in science (pp. 110-142). Greenwich, CT: JAI Press.

Ellerbruch, L. W., & Pyne, J. N. (1978). A teaching sequence for initial fraction concepts through the addition and unlike fractions. In M. Suydam (Ed.), Developing computational skills. Reston, VA: National Council of Teacher of Mathematics.

Engelhardt, J. M. (1977). Analysis of children's computational errors: A quantitative approach. British Journal of Educational Psychology, 47(2), 147-154.

Ettline, J. F. (1985). A uniform approach to fractions. Arithmetic Teacher, 32(3), 14-19.

Feldhusen, J. D., Hynes, K., & Ames, C. A. (1976). Is the lack of instructional validity contributing to the decline of achievement test scores? Educational Technology, 16(7), 13-17.

Fennema, E. (1974). Sex differences in mathematics achievement: A review. Journal for Research in Mathematics Education, 5(3), 126-139.

Fey, J. L. (1979). Perspectives from three national surveys for the elementary grades. The Arithmetic Teacher, 27(2), 33-42.

Floden, R. E., Porter, A. C., Schmidt, W. H., & Freeman, D. J. (1978). Don't they all measure the same thing? Consequences of selecting standardized tests. East Lansing, Michigan: Institute for Research in Teaching.

———————. (1981). Responses to curriculum pressures: A policy-capturing study of teacher decisions about content. Journal of Educational Psychology, 73(2), 129-141.

Fuson, K. C., & Hall, J. W. (1983). The acquisition of early number word meanings: A conceptual analysis and review. In H. P. Ginsburg (Ed.), The development of mathematical thinking (pp. 49-107). NY: Academic Press.

Freeman, D. J., Belli, M. G., Porter, A. C., Floden, R. E., Schmidt, W. H., & Schwidle, J. R. (1983). The influence of different styles of textbook use instructional validity of standardized tests. Journal of Educational Measurement, 20(3), 259-270.

———————. (1985). Do textbooks and tests define a national curriculum in elementary school mathematics. Elementary School Journal, 86(2), 141-152.

Gage, N. L. (1964). The theories on teaching. In L. L. Gage (Ed.), Handbook on research on teaching. Chicago: Rand McNally.

Gay, L. R. (1985). Educational evaluation and measurement: Competencies for analysis and applications. Columbus, Ohio: Charles E. Merrill.

Gagne`, R. M. (1977). The condition of learning. NY: Holt, Rinehardt & Winston.

Gibney, T., & Karns, E. (1979). Mathematics education, 1955-1975: A summary of the findings. Educational Leadership, 20(3), 356-359.

Ginsburg, H. P. (Ed.). (1983). The development of mathematical thinking. NY: Academic Press.

Good, R. (Ed.). (1973). Dictionary of education. NY: McGraw-Hill Book Co.

Green, D. R. (1982). Matching tests to curricula and test equating. Paper presented at the Annual Meeting of American Educational Research Association, New York City, NY. (ERIC. Document Reproductive Service, No. ED 218 313).

Green, O. A. (1963). Teacher-made tests. NY: Happer & Row Publishers.

Gronlund, N. E. (1971). Measurement and evaluation in testing. NY: Macmillan.

———————. (1982). Constructing achievement tests. Englewood, Cliffs, NJ: Prentice-Hall.

Gullikson, A. R. (1984). Teacher perspectives of their instructional use of test. Journal of Educational Research, 77(4), 244-48.

The Gulf Arab State Educational Research Center. (1981) (in Arabic). A comparative study of mathematics education among Arab Gulf State Members. Kuwait: The Gulf Arab State Educational Research Center.

Haertel, E. (1985). Construct validity and criterion-referenced testing. Review of Educational Research, 55(1), 23-46.

Haertel, E., & Calfee, R. (1983). School achievement: Thinking about what to test. Journal of Educational Measurement, 20(2), 119-132.

Hambleton, R. K., Swaminathan, H., Aligina, J., & Coulson, D. B. (1978). Criterion-referenced testing and measurement: A review of technical issues and developments. Review of Educational Research, 48(1), 1-47.

Hanson, R. A., & Bailey, J. D. (1982). Identification of instructionally sensitive items. Paper presented at the Annual Meeting of the National Council on Measurement in Education: New York City.

———————. (1983). Program-fair educational evaluation and empirical curriculum inquiry. Technical Report 82. (Los Alamitos, CA: SWRL Educational Research and Development).

Hanson, R. A., Behr, G. E., Meguro, B. T., & Bailey, J. D. (1980). Development and verification of instructionally sensitive achievement tests. Technical Report 69. (Los Alamitos, CA: SWRL Educational Research and Development).

———————. (1986). Differences in instructional sensitivity between items formats and between achievement test items. Journal of Edcuational Measurement, 23(1), 1-12.

Hanson, R. A., & Schutz, R. E. (1986). A comparison of methods for measuring achievement in basic skills program evaluation. Educational Evaluation and Policy Analysis, 8(1), 101-113.

Hardy, R. A. (1984). Measuring instructional validity: A report of an instructional validity study for Alabama high school graduation examination. Journal of Educational Measurement, 21(3), 291-301.

Harris, W. T. (1980). Textbooks and their uses. Education, 1(9), 32-38.

Hively, W. (1974). Introduction to domain-referenced testing. Educational Technology, 14(1), 5-10.

Hively, W., Petterson, H. L., & Page, S. A. (1968). A "universe-defined" system of arithmetic achievement tests. Journal of Educational Measurement, 5(3), 275-290.

Hoffer, A. (1983). Van Hiele--Based research. In R. Lesh & M. Landau (Eds.), Aquisition of mathematics concepts and processes (pp. 205-227). NY: Academic Press.

Horne, S. E. (1984). Criterion-referenced testing: Pedagogical applications. British Educational Research Journal, 10(2), 155-173.

Hudson, T. (1983). Correspondences and numerical differences between disjoint sets. Child Development, 54(1), 84-90.

Irvine, J. (1986). Teacher student interactions: Effect of student race, sex, and grade level. Journal of Educational Psychology, 78(1), 14-21.

Jacbos, J. E., & Eccles, J. S. (1985). Gender differences in math ability: The impact of media reports on parents. Educational Researcher, 14(3), 20-25.

Jakson, J. (1964). Analysis of a team teaching and of a self-contained homeroom experiment in grades five and six. Journal of Experimental Education, 32(4), 317-331.

Karner, R. E. (1977). The acquisition age of quantitative concepts of children from three to six years old. Journal of Experimental Education, 46(1), 52-59.

Keith, S. (1981). Politics of textbooks selection. CA: Institute for Research on Educational Finance and Governance.

Kellaghan, T., Madaus, G. F., & Airasian, P. W. (1982). The effects of standardized testing. Boston: Kluwer-Nijhoff.

Kilian, L. (1980). Errors that are common in multiplication. Arithmetic Teacher, 27(1), 22-25.

Kuhs, T. M., & Freeman, D. J. (1979). The potential influence on textbooks on teachers' selection of content for elementary school mathematics. Research Series No. 48. East Lansing, Michigan: The Institute for Research on Teaching.

Lambart, P., Goodwin, W. L., Roberts, P. F., & Wiersma, W. (1965). A comparison of pupil achievement in team and self-contained organizations. The Journal of Experimental Education, 33(3), 217-224.

Law, A. I. (1982). Survey of basic skills: Grade 6. Rationale and content. California State Department of Education, Sacramento, Office of Program Education and Research. (ERIC. Document Reproductive Service, No. ED 213 459).

Leinhardt, G., & Seewald, A. M. (1981). Overlap: What's tested, What's taught? Journal of Educational Measurement, 18(2), 85-96.

Lesh, R., & Landau, M. (Eds.). (1983). Acquisition of mathematics concepts and processes. NY: Academic Press.

Lesh, R., Landau, M., & Hamilton, E. (1983). Conceptual models and applied mathematical problem-solving reasearch. In R. Lesh & M. Landau (Eds.), Acquisition of mathematics concepts and processes (pp. 263-343). NY: Academic Press.

Linn, R. L. (1983). Testing and instruction: Links and distinctions. Journal of Educational Measurement, 20(2), 179-189.

Maccoby, E. E. (1966). Sex differences in intellectual functioning. In E. E. Maccoby (Ed.), The development of sex differences (pp. 49-60). Standford, CA: Standford University Press.

Madaus, G. F., Kellaghan, T., Rakow, E.A., & King, D. J. (1979). The sensitivity of measures of school effectiveness. Harvard Educational Review, 49(3), 207-230.

Madaus, G. F. (1983). Minimum competency testing for certification: The education and evaluation of test validity. In G. F. Madaus (Ed.), The court, validity, and minimum competency testing. Hingham, MA: Kluwer-Nijhoff.

Marshall, S. P. (1984). Sex differences in children's mathematics achievement: Solving computations and story problems. Journal of Educational Psychology, 76(2), 194-204.

Marshall, S. P., & Smith, J. D. (1987). Sex differences in learning mathematics: A longitudinal study with item and error analysis. Journal of Educational Psychology, 79(4), 372-383.

McKee, B. G., & Manning-Curtis, C. (1982). Teachers constructed classroom test: The stepchild of measurement research. Paper presented at the Annual Meeting of the National Council on

Measurement in Education. NY: (ERIC. Document Reproductive Service No. ED 222 562).

Mckillip, W. D. (1981). Computational skills in division: Results and implications from National Assessment. Arithmetic Teacher, 28(1), 34-37.

Mckillip, W. D. (1979). Teacher-made tests: Development and use. Arithmetic Teacher, 27(2), 38-43.

Mehrens, W. A. (1984). National tests and local curriculum: Match mismatch. Educational Measurement: Issues and Practice, 3(3), 9-15.

Mehrens, W. A., & Lehmann, I. J. (1987). Using standardized tests in education. NY: Longman.

Messick, S. (1975). The standard problem: Meaning and values in measurement and evaluation. American Psychologist, 30(10), 955-966.

———————— (1985). Response to changing assessment needs: Redesign of the NAEP. American Journal of Education, 3(2), 90-104.

Milazzo, P., & Buchanan, A. (1982). Equating instructional accomplishment inventories and standardized tests. Technical Report 77. (Los Alamitos, CA: SWRL Educational Research and Development).

Milazzo, P., Buchanan, A., Schutz, R.E. (1981). Mehtodology for analysis of IAI district level data bases. Technical Report 70. (Los Alamitos, CA: SWRL Educational Research and Development).

Ministry of Education. (1974). Planning of the daily lessons: Bloom's taxonomy. (in Arabic). Bahrain, Ministry of Education: Inservice Teacher Training.

Ministry of Education. Team of curriculum specialists (Eds.). (1981-82). Analytical study of mathematics curriculum at Bahrain elementary schools: Grade 1-6. (in Arabic). Bahrain: Ministry of Education.

Ministry of Education. (1981-85). Mathematics curriculum for Bahrain elementary schools: Syllabus. (in Arabic). Bahrain: Ministry of Education.

Ministry of Education. (1986). Mathematics curriculum for Bahrain elementary schools. (in Arabic). Bahrain: Ministry of Education.

Ministry of Education. Team of curriculum specialists (Eds.). (1986). Mathematics textbooks for Bahrain elementary schools: Grade 1; Part 1. (in Arabic). Bahrain: Arab Institute for Printing & Publishing.

Ministry of Education. Team of curriculum specialists (Eds.). (1986). Mathematics textbooks for Bahrain elementary schools: Grade 2. (in Arabic). Bahrain: Ministry of Information.

Ministry of Education. Team of curriculum specialists (Eds.). (1986). Mathematics textbooks for Bahrain elementary schools: Grade 3. (in Arabic). Bahrain: Ministry of Information.

Ministry of Education. Team of curriculum specialists (Eds.). (1986). Mathematics textbooks for Bahrain elementary schools: Grade 4. (in Arabic). Bahrain: Ministry of Information.

Miura, I. T. (1987). Mathematics achievement as a function of language. Journal of Educational Psychology, 79(1), 79-82.

O'Daffer, P. (1979). A case and techniques for estimation: Estimation experiences in elementary school mathematics--essential, not extra! Arithmetic Teacher, 26(6), 46-53.

Perrone, V. (1977). The abuses of standardized testing. Bloomington, Indiana: Phi Delta Kappan Educational Foundation.

Popham, J. W. (1971). Performance tests of teaching proficiency: Rationale development and validation. American Educational Research Journal, 8(2), 105-117.

————————. (1978). Criterion-referenced measurement. Englewood Cliffs, NJ: Prentice-Hall.

———————. (1980). Domain-referenced specification strategies. In R. A. Berk (Ed.), Criterion-referenced measurement: The state of art. Baltemore, MD: Johns hopkins University Press.

Popham, J. W., & Baker, E. L. (1970). Systematics instruction. NY: Prentice-Hall.

Popham, J. M., & Lindheim, E. (1981). Implications of a landmark ruling on Florida's minimum competency test. Phi Delta Kappan, 63(1), 18-20.

Price, E. B., Prescott, A. L., & Hopkins, K. D. (1967). Comparative achievement with departmentalized and self-contained classroom organization. Arithmetic Teacher, 14(3), 212-215.

Quinto, F. (1977). Teacher-made test--An Alternative to standardized tests. Standardized testing issues: Teachers' perspectives (pp. 50-60). Washington, DC: National Education Associates

Radatz, H. (1979). Errors analysis in mathematics education. Journal for Research in Mathematics, 10(2), 163-172.

Resmick, D. (1982). History of educational testing. In A. Wigdor & W. Garner (Eds.), Ability Testing (Vols. 2, pp. 173-194). Washington, DC: Natinal Academy Press.

Resnick, L. B., & Ford, W. W. (1981). The psychology of mathematics for instruction. Hillsdale, NJ: Lawrence Erblaum Associates.

Roberts, G. H. (1968). The failure of third grade arithmetic pupils. Arithmetic Teacher, 14(3), 442-446.

Roid, G., & Haladyna, T. (1980). The emergence of an item-writing technology. Review of Educational Research, 50(2), 293-314.

Rudman, H. C., Kelly, J. L., Wanous, D. S., Meherns, W. A., Clark, C. M., & Porter, A. C. (1980). Integrating assessment with instruction. The Institute for Research on Teaching, East Lansing, Michigan: Michigan State University.

Rush, G. M. (1929). The objectives or new-type examination. NY: Acott Foresman.

Saxe, G. B. (1979). Developmental relations between notational counting and number conservation. Child Development, 50(1), 180-187.

Saylor, J. M., Alexander, W., & Lewis, A. (1981). Curriculum planning for better teaching and learning. NY: Holt, Rinehart & Winston.

Schmidt, W. H. (1983). Content biases in achievement tests. Journal of Educational Measurement, 20(2), 165-178.

Schoenfeld, A. H. (Ed.). (1987). Cognitive science and mathematics education. Hillsdalle, NJ: Lawerance Erlbaum Associates.

Scott, R. O. (1983). Achieving curriculum alignment. Paper presented at the Annual Meeting of AERA (Montereal, Quebec, Canada, 1983). (ERIC Documents Reproduction Servise, No. ED 239 379).

Sindler, P. T., Gartland, D., & Wilson, R. J. (1984). The effects of lesson format on acquisition of mathematical concepts by fourth grades. Journal of Educational Research, 78(1), 40-44.

Singer, H., Ruddell, R. B., McNeil, J., & Wittrock, M. C. (1982). Testing achievement in basic skills (Vols. 1): Executive summary and research reports. California University, Riverside, School of Education. (ERIC Documents Reproduction Servise, No. ED 233 325).

Slavin, R. E. (1987a). A theory of school and classroom organization. Educational Psychologist, 22(2), 89-108.

————————. (1987b). Grouping instruction in the elementary school. Educational Psychologist, 22(2), 109-127.

Spencer, P. J., & Lester, F. K. (1981). Second graders can be problem solvers. Arithmetic Teacher, 29(1), 15-18.

Stake, R. E., & Easley, J. A. (Eds.). (1978). Case studies in science education. Urbana: University of Illinois. (ERIC Documents Reproduction Servise, No. ED 152 786).

Stiggins, R. J., & Bridgeford, N. J. (1985). The ecology of classroom assessment. Journal of Educational Measurement, 22(4), 271-286.

Stigler, J. M., Shin-ying, L., & Stevenson, H. W. (1987). Mathematics classrooms in Japan, Tawian, and the United states. Child Development, 58(4), 1272-1285.

Suhor, C. (1985). Objectives tests and writing samples: How do they affect instruction and composition. Phi Delta Kappan, 66(9), 635-639.

Tennyson, R. D., & Park, O. (1980). The teaching of concept: A review of instructional design research literature. Review of Educational Research, 50(1), 55-70.

Thorndike, R. L. (Ed.). (1971). Educational measurement. Boston, MA: Houghton Mifflin.

————————. (1982). Applied psychometric. Washington, DC: American Counsil on Education.

Thorndike, R. L., & Hagen, E. P. (1977). Measurement and evaluation in psychology and education. NY: John Wiley & Sons.

Troutman, A. P., & Lichinberg, B. P. (1974). Problem solving in the general mathematics classroom. Mathematics Teacher, 67(6), 590-597.

Tyler, W. R., & White, S. H. (Eds.). (1979). Testing, teaching and learning: Report of a Conference on Research on Testing (Augest 17-26, 1979). Washington, DC: The National Institute of Education.

Underhill, R.G., Uprichard, A. E., & Heddens, J.W. (1980). Diagnosis mathematical difficulties. Columbus, Ohio: Charles E. Merrill.

Usiskin, Z. (1982). Van Hiele levels and achievement in secondary geometry (Final report of the cognitive development and achievement in secondary school geometry project). Chicago: University of Chicago: (ERIC Documents Reproduction Servise, No. ED 220 288).

Ward, P. E. (1970). A study of pupil achievement in departmentalized grades four, five and six. Dissertation Abstract International, 30, 4749A. (University Microfilms No. 70-1201).

Wilson, S. M., & Hiscox, M. D. (1984). Using standardized tests for assessing local learning objectives. Educational Measurement: Issues and Practice, 3(3), 19-21.

Woods, S. S., Resnick, I. R., & Grsen, G. J. (1975). An experimental test of five process models for subtraction. Journal of Educational Psychology, 67 (1), 17-21.

Yalow, S. E., & Appel, E. M. (1983). Even coin has two sides: The court, validity, and minimum competency testing. Contemporary Education Review, 2(1), 43-52.

Yalow, S. E., & Popham, W. J. (1983). Content validity at the crossroads. Educational Researcher, 12(8), 10-21.

Zweng, M. H. (1977). The problem solving story problems. Arithmetic Teacher, 27(1), 2-3.

APPENDIXES

APPENDIX A

OLD MATHEMATICS CURRICULUM FOR BAHRAIN ELEMENTARY SCHOOLS (1981-85)

APPENDIX A

OLD MATHEMATICS CURRICULUM FOR BAHRAIN ELEMENTARY SCHOOLS (1981-1985)

General Objectives of Bahrain Old Mathematics Curriculum:

At the end of elementary school the students should be able to:

1. Know mathematics facts and concepts that are adequate to their intellectual development.
2. Possess the ability to deduce the relationship between mathematical concepts and facts.
3. Possess the ability to do computation of basic"facts' operations with accurate and speed.
4. Recognize the importance of mathematics in everyday life activities.
5. Possess the basic mathematical concepts and knowledge to use them in the other level of education.
6. Possess the ability in using mathematics knowledge in solving mathematical and nonmathematical problems.
7. Posses the ability of appreciation to mathematical knowledge.

Content of Mathematics at Grade 1:

A. Sets:
   1. Set concept.
   2. Set element, belong.
   3. Subsets.

B. Numeration System:
   1. Study of number to 10.
   2. Read/write number to 10.
   3. Greater/less than.
   4. Read/write numbers to 99.
   5. Study number to 99.
   6. Read/write number to 99.
   7. Place-value for specific number to 99.
   8. Names of numbers (verbal, written and words).
   9. Count by 10.

C. Operation on Sets:
   1. Union sets as introduction to addition.
   2. Separation of sets as introduction to subtraction.
   3. Commutative/distributive properties.

4. Zero as a neutral element.
5. Associative/transitive properties for "less than".

D. Basic Addition/Subtraction Facts:
1. Addition facts with 5 and 10.
2. Addition facts to, 18.
3. Addition table.
4. Subtraction facts with 5 and 10.
5. Addition and subtraction as an inverse operation.
6. Addition of 2-place number with 1-place number without renaming.
7. Addition 2-place number with 2-place number without renaming.
8. Check addition/subtraction operations.

E. Logic:
1. Use open mathematical sentences.
2. Mathematical equation included: +, -, or =.

F. Fraction:
1. Fraction concepts of 1/2, 1/4, 1/3 with one similar unit.
2. Local currency: Fils and Dinar (one dinar equal to 1000 fils).

G. Geometry:
1. Opened-closed curves.
2. Area (inside, outside).
3. Drawing closed-curves around specific set.
4. Recognition of: Square, triangle, circle and rectangle.

Content of Mathematics at Grade 2:

A. Sets:
1. Equivalent sets.
2. Set union.
3. Subsets

B. Numeration System:
1. Read/write number to 999.
2. Number Comparison.
3. Different names for numbers.

C. Operation on Sets:
1. Combine two sets.
2. Separate one set into two nonequal subsets.
3. "Take away" a subset from a set.

D. Operation on Numbers:
1. Possess accurately basic

addition/subtraction "facts".
2. Addition and subtraction as an inverse operation.
3. Commutative property and addition operation.
4. Add 2-place number with/without renaming.
5. Subtract 2-place number with/ without renaming.
6. Add 3-place number with/without renaming.
7. Subtract 3-place number with/without renaming.
8. Multiplication Concepts.
9. Use segment line to clarify multiplication concept.
10. Give products for basic multiplication "facts" to 9 X 9 = ?
11. One is a neutral element in multiplication.
12. Division concept
13. Basic division "facts" and related to basic multiplication "facts".
14. Division operation by division table without remainder.

E. Logic:
1. Use symbol of IF THEN ($\longrightarrow$).
2. Mathematical equation included: <, >, +, =.

F. Fraction:
1. Fraction concepts of 1/2, 1/4, 1/3, 1/4, 3/4 2/3.
2. Give a fraction for a part of a region.

G. Measurement:
1. Dinar and its notation.
2. Time: Week's days.

H. Geometry:
1. Concept of length.
2. Measure of length.

Content of Mathematics at Grade 3:

A. Sets:
1. Equivalent sets.
2. Join two equivalent subsets in one set.
3. Correspondence property: one-to-one, many-to-one.

B. Numeration System:
1. Read/write standard numeral to 99999.
2. Place-value to 99999.
3. Order and Number Comparison.

C. Operation on Numbers:
1. Use number line to indicate multiplication/division operation.
2. Add/subtract 5-place number with/without renaming to 99999.
3. Basic multiplication "fact" and is relationship to

basic division "facts".
4. Multiplication factors as 1, 2, 3,..9.
5. Multiply 1-place number by 10s, 100s.
6. Inverse and distributive properties and multiplication.
7. Multiply by zero.
8. Multiply 1-place number with 2-place number with/without renaming
9. Divide 2-place number with 1-place and check the answer.
10. Relate addition/subtraction expressions to representation of sum/differences.

D. Logic:
*. Revise the same logic concepts of grade 1 and grade 2.

E. Fraction:
1. Study 1/2, 1/4, 1/3, 1/4, 3/4 2/3..9/10 by region and set concept.
2. Equivalent fractions.

F. Measurement:
1. Local currency and Saudi Arabia currency.
2. Arabic months.
3. Year's calendar.
4. Metric measures.

G. Geometry:
1. Read/write point, curve, lines, segment, rays.
2. Union of two rays to give an angle.
3. Perpendicular segment, parallel segments.

Content of Mathematics at Grade 4:

A. Sets:
1. Set concept, element, belong and empty set.
2. Subsets, equal sets, equivalent sets.
3. Intersect, union.

B. Numeration System:
1. Analyze number to its original factors.
2. Odd/even numbers and whole number
3. Read/write numbers to million.
4. Place-value of specific number to million.

C. Operation on Numbers
1. Add/subtract 9-place number with/without renaming.
2. Multiply 1-place number with 3-place number with/without renaming
3. Divide 3-place number with 1-place and check the answer.
4. Possess long form division.

D. Logic:
*. Revise the same logic concepts of grade 1-3.

E. Fraction:

1. Fraction comparison.
2. Add fractions with like denominators.
3. Mixed numbers and uncommon fractions.
4. Add/subtract mixed fractions with like/unlike denominators.
5. Decimals (1/10, 1/100).
6. Add/subtract decimals.

F. Measurement and Measures:

1. Time: Second, minute, hour, day.
2. Length: Metric system and its notation (meter, kilometer..).
3. Weight: gram, kilogram, metric ton (application on basic operation).

G. Geometry:

1. Relate point with lines (on line, out of the line).
2. Measure and draw right, acute and obtuse angles.
3. Triangles and its types according to: Sides and angles.
4. Triangle, square, rectangle circumferences.
5. Three-dimensional shapes: cube, sphere, cylinder and rectangle solid.

H. Problem Solving:

*. Word problems are distributed within grades and across grades in the textbooks in most mathematical topics.

APPENDIX B

NEW MATHEMATICS CURRICULUM FOR BAHRAIN ELEMENTARY SCHOOLS (1985-1986)

APPENDIX B

NEW MATHEMATICS CURRICULUM FOR BAHRAIN ELEMENTARY SCHOOLS (1985-1986)

General Objectives of Bahrain New Mathematics Curriculum:

At the end of elementary school the students should be able to:

1. Know mathematics facts and concepts which are used in everyday life.
2. Develop concepts of quantity and quantity relationship.
3. Possess the ability of deduction of mathematical concepts and facts through clear demonstration in the textbooks.
4. Possess the ability to do computation of basic "facts" operations with accuracy and understanding.
5. Possess manual skills of using geometrical tools and drawing geometrical figures.
6. Possess the ability of implementing mathematical information and skills in solving mathematical and nonmathematical problems.
7. Develop the ability of appreciation of mathematical computation and measurement.
8. Recognize the importance of mathematics in everyday life activities.
9. Develop positive attitude towards mathematics.

Specific Objectives of Mathematics of Grade 1 in Bahrain Elementary Schools (1986-1987:

At the end of grade 1 the students should be able to:

A. Sets:

1. Indicate the specific properties of something.
2. Classify things into groups according to one/two properties (e.g., color, shape, color and shape).
3. Indicate elements that are inside or outside the set or group.
4. Compare between two sets by using more/less than.
5. Organize groups or sets according to the number of the elements.
6. Find the results of additive sets from two disjointed sets.
7. Find the remainder set from original set after "take away" one subset.

B. Relationship:

*. Contrast between two lengths by using far away, near to or the same distance.

C. Recognition and Comparison of Numbers:

1. Indicate the symbol of the number for the same set element.
2. Read/write symbols of essential numbers 0-9.
3. Compare between two numbers by using more/less than, or equal to.
4. Order the number from 0 to 9.

D. Addition/subtraction facts:

1. Give sum of addition for two numbers each consists of 1-digit to 9.
2. Give sum of addition for two numbers each consists of 2-digit to 99.
3. Give differences of subtraction for two numbers each consists of 1-digit to 9.
4. Give differences of subtraction for two numbers each consists of 2-digit to 99.
5. Relate addition/subtraction operations.
6. Use associative properties in relation to addition and subtraction operations.
7. Solve an opened mathematical sentences which include +, - symbols.

E. Fraction:

1. Indicate the shaded or unshaded locations (parts) for 1/2 and 1/4.
2. Read/write two fractions:1/2 and 1/4.

F. Geometry

1. Draw opened-closed curves.
2. Know 3-dimensional shapes: Cubic, Cylinder, Sphere.
3. Know parts of: Square, rectangle, circle and triangle.

G. Measurement:

1. Give one fils value of individual coins: 5 fils, 10 fils,or 100 fils.
2. Name the week's days.
3. Use verbal expression for: day, yesterday or tomorrow.

H. Problem Solving:

*. Solve simple word problems, by using of graphs, drawing and pictures.

Content of Mathematics at Grade 1:

A. Sets:

1. Classification of things according to one/two specific property/(ies): Color, type, or shape, color and shape color and volume.
2. Set Comparison (more/less than or the same as).

3. Set equivalency.
4. Add two separate sets.
5. Find a set after "take away" a subset from original set.

B. Relationship:
1. Inside/outside, more/less than or equal.
2. Longer/shorter than, far/near to.

C. Whole Numbers:
1. Symbol and concept of number for to 9.
2. Standard numeral from 0 to 9.
3. Counting, order and comparison numbers to 99.
4. Zero number concept (read/write and symbolized).
5. Number 10 concept (read/write and symbolized).
6. Ordinal counting from 1 to 10.
7. Standard numeral from 1 to 99.
8. Place-value of numbers to 99.
9. Different names of numbers to 99.

D. Operation on Numbers::
1. Addition Concept and its symbol (+).
2. Addition facts to 18. each consists of 1-digit to 9.
3. Zero with addition operations.
4. Subtraction Concept and its symbol (-).
5. Relate addition/subtraction expression to represent of sums or differences.
6. Opened sentences give +, -, = according to addition/subtraction facts.

E. Fraction:
*. Common fractions: 1/2 and 1/4.

F. Geometry
1. Opened-closed curves.
2. 3-dimensional shapes: Cubic, Sphere.
3. Square, rectangle, circle and triangle.

G. Measurement:
1. Bahrain currency.
2. Week-days.

H. Problem Solving:
*. Single statement word problems, using graphs, drawing and pictures.

Specific Objectives of Mathematics of Grade 2 in Bahrain Elementary Schools (1986-1987:

At the end of grade 2 the students should be able to:

A. Sets:
1. Compare among sets and equivalent sets.
2. Express the products of multiplication of 2 numbers (multiplication facts tell 5 X 5).

B. Relationship:

1. Use >, <, or = in comparing whole numbers.
2. Compare between weight by using heavier/lighter than.

C. Recognition, Order and Comparison of Numbers:
1. Indicate Place-value of numbers to 999.
2. Read/write numbers consist of 3-digit to 999.
3. Order ordinal numbers to 999.

D. Addition/Subtraction Algorithm:
1. Give sum of addition for two numbers each consists of 2-digit with/without renaming.
2. Give differences of subtraction for two numbers each consists of 2-digit to 999 with/without renaming.
3. Give differences of subtraction for three numbers each consists of 3-digit to 999.

E. Multiplication Facts:
1. Know products of multiplication concepts and its symbol (X).
2. Give products of multiplication for one number with 1-digit to 5 X 5.
3. Solve open sentences consist of =, -, +.

F. Fraction:
*. Read/write two fractions: 1/2, 1/4 1/3, 2/3, 3/4 and compare among these fractions.

G. Geometry
1. Identify curve and segment.
2. Recognize 3-dimensional shapes: Cube, Cylinder, Sphere.
3. Identify Square, rectangle, circle and triangle.

H. Measurement:
1. Solve simple word problems include currency.
2. Read time.
3. Compare lengths and weights.
4. Measure the length and weight within different improper units.

I. Estimation:
*. Use estimation for addition/subtraction operations.

J. Problem Solving:
*. Solve simple word problems, by using drawing which are consisted of basic addition/subtraction facts.

Content of Mathematics at Grade 2:

A. Sets:
*. Equivalent Sets.

B. Relationship:
1. Greater/less than and their symbols >, <.
2. Equal to and its symbol =.

C. Whole Numbers:

1. Standard numeral from to 999 (read/write).
2. Place-value of number to 999.
3. Number order to 999.

D. Operation on Numbers:

1. Add/subtract 2-place number with 1-, 2-place number with/without renaming.
2. Add/subtract 3-place number with 1-, and 2-place number to 999.
3. Add/subtract 3-place number with 3-place number to 999 no renaming.
4. Multiplication concept and its symbol (X).
5. Multiplication facts to 5 X 5.
6. Opened sentences include +, -, =.
7. Simple number pattern.

E. Fraction:

*. Common fractions: 1/2, 1/4, 1/3, 2/3 3/4 (read and write).

F. Geometry

1. Tell: curve, segment.
2. Tell: Cubic, sphere, cylinder, rectangular solid.
3. Know: Square, rectangle, circle and triangle.

G. Measurement:

1. Bahrain currency.
2. Time: Week, days and hour.
3. Concept of length and weight and length comparison.
4. Measure of length and weight with improper units.

H.Rounding and Estimation:

.* Nearest estimated sums/differences according to simple addition/subtraction problems.

I. Problem Solving:

*. Single statement word problems, include addition/subtraction facts using drawing and pictures.

Specific Objectives of Mathematics of Grade 3 in Bahrain Elementary Schools (1986-1987:

At the end of grade 3 the students should be able to:

A. Sets:

1. Identify two sets have the same number of element.
2. Deduce concept of multiplication through equivalent and separated sets.
3. Use sets language to identify some multiplication facts as 9 X 9.

B. Relationship:

* Distinguish the capacity between containers.

C. Recognition, Order and Comparison of Numbers:

1. Indicate Place-value of numbers to 9999.

2. Read/write standard numerals to 9999.
3. Order numbers ascendant/descendent to 999.
4. Compare between numbers to 9999.
5. Count by 2, 5, 10 and 3.

D. Addition/subtraction Algorithm:
1. Give sum of addition for two numbers with 4-digits with/without renaming.
2. Give differences of subtraction for two numbers each consists of 4-digit with/without renaming.

E. Multiplication Facts:
*. Give products of multiplication for one number with 1-digit to 9 X 9.

F. Division Facts:
1. Know division concept and its symbol (-).
2. Give dividend of division for one number with 1-digit to 6 - 6, no zero division.

G. Algorithm (X, -):
1. Give products of multiplication of 1-place value number.
2. Give products of multiplication for one number with 1-digit to 9 X 9.
3. Solve open sentences consist of +, -, =, X, -, < or >.

H. Fraction and Fraction Computation:
*. Read/write two fractions that are less than one and their denominators from 2 to 10.

I. Geometry
1. Identify point, curve and segment.
2. Compare the length of segment by improper units.
3. Measure length of segment by estimation.
4. Draw a segment with proper measure.
5. Find circumferences of some figures without mathematical laws.
6. Solve some problems regarding circumferences.

J. Quantity and Measurement:
1. Read/write currency.
2. Know Arabic Gulf States currency.
3. Read time in hours.
4. Use metric units (meter and centimeter).
5. Use time units (month, year, Hegric months, hour).
6. Use metric weight units (kilogram, gram).
7. Solve problems regarding measurement units.

K. Rounding and Estimation:
1. Estimate the time.
2. Estimate the length.
3. Estimate the sum/differences of basic operation computation.

L. Problem Solving:
1. Solve word problems (simple and multi), with step-by-step according to the following:

(a) Getting to know the problem; seeing what is given and understand what is asked.
(b) Devising a plan; figuring out what to do.
(c) Carrying out the plan; doing it.
(d) Looking back; evaluating the solution (Polya's [1945] solution steps).

2. Explain a graph and use the information to solve the problem.

Content of Mathematics at Grade 3:

A. Sets:
1. Add equivalent/separated sets.
2. Separate sets into subsets.

B. Relationship:
* Greater capacity/less capacity than.

C. Recognition, Order and Comparison of Numbers:
1. Place-value to 9999.
2. Standard numerals form to 9999.
3. Order numbers ascendant/descendent.

D. Operation on Whole Numbers:
1. Multiplication Facts to 9 X 9.
2. Division concept.
3. Relate multiplication and division expression to representation of products and quotients.
4. Multiply by 10s and its doubler as 20s, 30s, ...90s.
5. Multiply 2-place number with 1-place number with no renaming.
6. Solve open sentences consist of +, -, =, X, -, < or >.
7. Add/subtract 3-place number with 3-, 4-place number to 9999.

E. Fraction and Fraction Computation:
*. Read/write two fractions that are less than one and their denominators from 2 to 10.

F. Geometry
1. Point, curve and segment.
2. Length of different segments.
3. Measure length of segment.
4. Circumferences of: square, triangle, and rectangle without mathematical laws.
5. Circumferences.

G. Quantity and Measurement:
1. Arabic Gulf States currency.
2. Metric length units (meter and centimeter).
3. Time units: month, year, hour, 1/2 hour, 1/4 hour and 1/3 hour.
4. Metric weight units (kilogram, gram).

H. Rounding and Estimation:

1. Nearest or estimate results of some basic operations.
2. Estimate a length of segment to the nearest unit.

I. Problem Solving:

*. Solve word problems (simple and multi) related to everyday life experiences according to:
   (a) identify the situation to indicate the given information and what the problem want you to find;
   (b) select the appropriate mathematical operation for the solution;
   (c) solve the problem; and
   (d) check your answer.

Specific Objectives of Mathematics of Grade 4 in Bahrain Elementary Schools (1986-1987):

At the end of grade 4 the students should be able to:

A. Recognition, Order and Comparison of Numbers:
1. Identify Place-value for a given numbers.
2. Read/write numbers that are include 5- to 7-digits.
3. Order numbers ascendent/descendent.
4. Distinguish between odd and even numbers.
5. Find a doubler of a given number.

B. Addition/subtraction Algorithm:
1. Give sum of addition for two numbers with 5- to 7-digits.
2. Give differences of subtraction for two numbers each consists of 5- to 7-digit.

C. Algorithm (X, -):
1. Multiply by 10, 100 or 100.
2. Divide by 10, 100 or 100.
3. Multiply 2-place value number by 2- or 3-place value number.
4. Divide 1-place value number with 1-place value number with remainder.
5. Divide 2- or 3-place value number with 1-place value number with renaming.
6. Deduce the divisor that is equal to divisor multiply by dividend plus the remainder.
7. Compute some problems that are include all four operations.
8. Identify some models of odd/even numbers.

D. Fraction and Fraction Computation:
1. Write fractions with different models.
2. Compare between two fractions that have equal denominators or one fraction has a duplicated denominator.

3. Add/subtract two fractions which one has a denominator that is duplicated the other fraction denominator.
4. Read/write fraction numbers.
5. Add/subtract fraction numbers with like denominators with renaming.
6. Identify decimal number with 3-place value.
7. Transfer decimals to fractions.
8. Use the relationship between metric and money in order to clarify the decimal number.
9. Compare between decimal numbers.

E. Geometry

1. Know line and ray.
2. Draw and express with symbols: segment, point, ray and line.
3. Know different position of two lines: parallel, perpendicular.
4. Know characteristics of: square, triangle.
5. Draw a square/rectangle by using ruler and right angle triangle tools.

F. Quantity and Measurement:

1. Measure a segment with improper units.
2. Find areas of some figures without proper mathematical relationship.
3. Find a circumference of square and rectangle by applying mathematical relationship.
4. Use metric length units to measure a length of line, segment..
5. Solve problems that are included time units.

G. Rounding and Estimation:

1. Round number to the nearest 10, 100.
2. Use rounding estimate some mathematical operations.
3. Justify by estimation/rounding the correct answer for some mathematical operations.
4. Estimate heights/weights for some natural things like mountains.
5. Estimate time in everyday life activities.

H. Problem Solving:

1. Solve word problems (simple and multi), with step-by-step according to the following:
   (a) Getting to know the problem; seeing what is given and understand what is asked.
   (b) Devising a plan; figuring out what to do.
   (c) Carrying out the plan; doing it.
   (d) Looking back; evaluating the solution (Polya's solution steps).
2. Solve some quantitative problems related to everyday life phenomena.

Content of Mathematics at Grade 4:

A. Recognition, Order and Comparison of Numbers:

1. Place-value for specific number to million.
2. Read/write numbers of 5- to 7-digits.
3. Order numbers ascendent/descendent.
4. Odd and even numbers.
5. Doubler of a given number.

B. Basic Facts (+, -):

*. Expand addition/subtraction operations.

C. Basic Facts (X, -):

1. Multiply by 10, 100, 1000 and their multiples.
2. Divide by 10, 100 or 1000.

D. Algorithm (X, -):

1. Multiply 1-place value number by 2- or 3-place value number with no renaming.
2. Divide 2-place value number with 1-place value number with remainder.
3. Divide 3-place value number with 1-place value number with remainder.
4. Multiply 2-place number by 2-place number with renaming.
5. Divide by 2, 5 and 10 as factors without remainder.
6. Open mathematical sentences of: +, -, X, -, =, < or >.
7. Number Patterns.

E. Fraction and Fraction Computation:

1. Write fractions with different types.
2. Compare between two fractions with denominators.
3. Add/subtract two fractions with like denominator.
4. Mixed Fractions.
5. Add/subtract mixed fractions with like denominators with no renaming.
6. Decimal number with 3-place value.

F. Geometry

1. Know line and ray (their symbols).
2. Angle concept and naming.
3. Know right angle without measurement.
4. Know intersect lines, line and ray connect, parallel and perpendicular lines.
5. Characteristics of square and rectangle.
6. Draw a square/rectangle by using ruler and right angle triangle tools.
7. Circumferences of square and rectangle by mathematical laws.
8. Area concept and area of square and rectangle.

G. Quantity and Measurement:

1. Improper area units.
2. Length metric units (kilometer, meter.).

3. Time: second, minute, hour and days and their relationship.
4. Practical applications for length and time units.

H. Rounding and Estimation:
1. Rounding numbers to nearest 10, 100.
2. Estimate time, distance and weight.
3. Estimate some mathematical operations.

I. Problem Solving:
1. Solve word problems (simple and multi), with step-by-step according to the following:
   (a) Getting to know the problem; seeing what is given and understand what is asked.
   (b) Devising a plan; figuring out what to do.
   (c) Carrying out the plan; doing it.
   (d) Looking back; evaluating the solution (Polya's solution steps.
2. Solve some quantitative problems related to everyday life phenomena.

APPENDIX C

CHART. MAPPING OF THE CURRICULUM OBJECTIVES AND TEXTBOOKS COVERAGE (GRADE 1-4).

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Curriculum objectives/ textbook coverage	Page #	# of lessons
GRADE 1		
1. Classification according to one/two specific properties: Size color, size & color. These pages concern the classification concept which is shown in different ways. Students use their color pencils to identify some of these properties.	7-13	18
2. Open-close curves. These pages concern introduction of opened-closed curves concept. Student identify some names of sets to the given example.	14-17 19-29	12
3. Pattern. In these pages students use coloring to identify right from left position according to a given example.	28-30	
4. Greater/taller/same as/heavier than. These pages concern shorter/longer concepts. Students carry their own experiences to grasp some of these concepts.	31-32	
5. Matching one-to-one. These pages concern matching sets that contain the same number of elements.	35-36	
6. Set comparison. Student compare between sets elements. "No direction is given". Probably it relates to matching concept.	37-39	

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
7. Matching one-to-many.	40-41	
These pages concern matching sets that contain the same number of elements.		
8. Number concepts 1-5.	42-58	10
To establish the concept of particular number (1-5). The pages concerned the following: Students (a) work with sets that can be matched one-to-one, (b) learn that if 2 sets can be matched one-to-one then for every object in one set there is an object which we call number. The key concepts are: (1) All sets that can be matched one-to-one with set {O} contain the same number of objects, and/or an equivalence class of sets with cardinal number 1. (2) Cardinal numbers answer questions "How many?" Moreover, in page 45 another exercises were introduced ("How many in each set?" Ring the answer.)		
9. Number concepts 6-9.	60-77	10
These pages continue the development of specific sets and numerals (6-9). All the exercises vary from "Ring the answer" to write the cardinal number. Some exercises deal with comparison between numbers by matching one-to-one or more/less than concepts. There was no exercises for establishing number concept of (6-9) as same as to the previous numbers (1-5).		
Exercises emphasize the relationship of more/less than, order numbers from large to small.	66-75	
10. Zero number.	78-79	2
No coverage in the textbook to the empty set and cardinal number zero. Directly the pages covered the comparison between empty set and cardinal number 4.		
11. Number 10 concept.	80-82	3

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
These pages continue to compare between two numbers 9 & 10. No introduction to number 10. Recognizing numbers and numerals.		
12. Word problems practice.	83-85	3
In page 83, the exercises dealing with identification of numeral numbers 1-10, left/ right position. In pages 84-85 simple word problems with "how many" concept are presented.		
13. Basic facts (+) 0-10.	86-108	36
These pages include a variety of exercises: (a) two sets may be joined to form a new set, (b) addition of cardinal numbers; is the of operation associated with joining sets. (c) in addition 2+3=5, the 2 and 3 are called addends and the 5 is called the sum. These pages complete the transition from joining sets to the addition of numbers stated in the form of equations. In these pages students are introduced to the plus and equal signs, and learn 4+2= is a number sentence indicating that these two numerals (4+2) and 6) name the same number.		
14. Word problems (simple).	109	10
This page concerns the application of addition operation. (money problems).		
GRADE 2		
1. Sets.	11-38	9
These pages present no new mathematical ideas, rather, they review the ideas covered in the previous grade: joining, separating, Cardinal numbers 1-100, base of numeral system is 10 (face & place value), relations <, >., true-false.		

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
2. Basic facts (+,-)	19-39	9

These pages contain: (a) sets may be joined and separated. The associated numbers operations are addition and subtraction respectively, (b) the process of naming a sum, given two addends, is called addition. Given the sum and one addend naming the missing addend is called subtraction, (c) the associative property of addition means that the order in which addends are grouped do not affect the final sum. Moreover, these pages present the sequence of presentation for basic facts of 9+9=18. Colored rods are used in these pages to reinforce the addition and subtraction facts, consist of vertical form which students are to complete with/without the aid of set presentation. Emphasis is on the idea of addition and subtraction are inverse operations. Zero is the identity element of addition. For any number a, a+0=a. Addition forms a+0=a are taught in terms of the basic property of zero as an addend, rather than as separate facts.

3. Add/subtract 2-place number with 1-place with renaming.	40-47	6

These pages include: (a) a 2-place numeral may be written as the sum of tens & ones. E.g., "35 may be renamed as 30+5", (b) An addition such as 35+24 explains by means of renaming principles, as illustrated below:

"35+24 = (30+5)+(20+4)
= (30+20)+(5+4)
= 50 + 9
= 59".

Or to emphasize the separate addition of tens & ones. E.g., "3 tens 5 ones
2 tens 4 ones
---
5 tens 9 ones
59".

(c) same mathematical ideas are completed in the

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
subtraction of 2-place number. E.g., "Tens Ones 40 + 7 - 10 - 3 30 + 4 34.		
4. Algorithms (+, -).	46-62	12
Pages from 49-52, include add/subtract 1-, and 2-place value with 2-place value with/without renaming. In these pages no ideas are introduced.		
5. Subtract 2-place value with 2-place number with renaming.	54-60	12
The key mathematical concepts are: A number is a name for a numeral; Every number has number with many names, E.g., "37 and 30+7 are two names for the same number. The first of these names stresses the place value; the second is the expanded form and stresses the addition of total value; Addition is the number operation corresponding to the joint or disjoint sets. Addition may also be defined as the process of renaming two addends as a sum; Subtraction is the number operation corresponding to the separation or comparison of sets. It may be defined as the process of renaming as sum and one addend as the missing addend; Addition is associative and commutative; Addition and subtraction are opposite operations; The equation (statement) includes horizontal and vertical (computation) forms follow the same principles as illustrated below: "46 = 40 + 6 = (30+10) + 6 - 28 =-20 - 8 = - 20 - 8 = 30 + 16 = -20 - 8 = 10 + 8 = 18".		

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
6. Place-value for a specific number.	63-76	12

These pages develop that 100 is 10 tens. At this stage, the student using terms such as "ten tens" to make sure that they fully understand the concept. The key concepts are: In our system of numeration the third place from the right is the hundreds' place and the second place from the right is the tens' place. Tens sets of ten may be represented by the numeral 100. E.g.,

"340: Hundreds Tens One
300 40 0

The abacus, the place-value chart, columns, and expanded numeral are all methods used in textbook to provide the experience necessary to develop this concept.

7. Add/subtract 3-place number with 3-place.	78-91	12

In these pages the with 3-place algorithm operation within 3-place number in both addition and subtraction. In the exercises the students are asked to rename the addends of sums in expanded notation before they add or subtract. E.g., The three steps methods introduced here as a transition to the standard method. It presents in vertical form:

```
  256   Write 9 in 1s' place
+ 123   Write 70 in 10s'place
  ---
  379   Write 300 in 100's place
```

Same steps in subtraction were used.

8. Measurement of length.	93-96	12

These pages concern a comparison of an nonstandard unit and object being measured. The students should realize that measurement is basically a form of counting. They select a unit, and then count how many of these units are contained in the object to be measured.

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
9. Basic multiplication facts.	97-118	30
These pages concern the multiplication concept as related to: joining of the equivalent sets, addition of equal addends, renaming procedures, commutative and associative properties, one is the identity element, and multiplication table. Students solve variety of exercises.		
10. Basic division facts.	119-127	15
To establish the division concept the students should realize that: Division and multiplication are opposite operations, E.g., 7X2=14, 14-2=7; All division may be developed from the basic multiplication-division facts; separation of a set to form a number of equivalent subsets is the set operation which corresponds to the number operation division. Most division-multiplication facts may be stated in a form of a family of four equations.		
11. Fraction recognition.	130-136	12
Review of the fractional numbers: 1/2, 1/3 1/4, 1/5. in the previous grade were presented in pages 130-131. From pages 132, a new fractional numbers are introduced: 1/5-1/10 & 3/4...4/7. The exercises emphasize fraction recognition through the separation of a set into two equivalent subsets.		
12. Money	137-138	6
These pages present no new mathematical ideas, rather, they present an opportunity to revise and emphasize the money concept in previous grade.		

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
13. Time These pages present the time concept: 1/2-hour, 1/4-hour, and one hour. The numeral on a clock face can be reviewed as a special kind of line number. The week-days concept establishes: writing the days of the week.	139-143	12
GRADE 3		
1. Sets. These pages revise set concepts that were covered in the previous grades 1-2.	10-24	12
2. Whole numbers: 100-1,000. These pages revise numbers: the recognition, order, and comparison of the whole numbers that covered in the previous grades 1-2.	25-27	6
3. Basic facts (+, -). These pages revise the basic addition/ subtraction facts that covered in the previous grades 1-2.	28-30	6
4. Fractions recognition. These pages revise the recognition of some fraction numbers: 1/2, 1/3...that were covered in the previous grades 1-2. Emphasize on the equivalent parts and regions, fraction comparison (greater/smaller than).	31-34	4
5. Set comparison. Emphasis on the relationships notations (<, >).	34-35	2
6. Equivalent sets	36-37	2

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
12. General practice.	64-66	3
Students work with exercises include word problems.		
13. Geometry.	67-70	4
These pages concern: (a) a point is an an abstract idea, which like a number, cannot be seen, touched, or drawn, It represents by physical model, usually a dot; (b) A line is a straight curve that extends indefinitely in either direction. We name it AB which is read "the line AB"; (c) a line segment is part of a line. It written AB, (d) A ray is part of a line with only one end point. It written AB, and (e) An angle is a geometric figure formed by two rays which have a common end point. It written ABC.		
14. Multiplication/addition operations related to commutative property.	71-74	3
No new mathematical concept is presented. The emphasis on the relationship of commutative property and multiplication-addition operations. E.g., "4 X 2 X 3 = (2X4) X 3 = 8 X 3 = 24".		
15. General practice.	75	1
Student solve practice exercises include: add 3-place number with 3-place number, word problems solving applied all computational operations.		
16. Multiplication.	76-77	2
No new mathematical concept is presented. Word problems presented.		
17. Basic multiplication/division facts to 9 X 9 = .	80-81	2

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
No new mathematical multiplication concept is presented, rather, the emphasis on the division/ multiplication basic facts to 9X9. Word problems is presented.		
18. General practice.	82-84	3
Students work with practice exercises include word problems.		
19. Fraction recognition.	85-89	5
No new mathematical concept is presented rather, the emphasis on parts and regions for some common fraction: 2/3, 3/4..etc.		
20. General practice.	90	1
Students work with exercises include word problems.		
21. Money.	91-100	2
Students work with objects grouping them into sets of ten by counting. In conjunction with the teaching money value ones, tens and hundreds related to fils and dinars in this pages. Dinars and fils used to reinforce the concept of place value. A set of 1,000 fils is equivalent to 1 dinar. Call students' attention to the meaning and usage of the word fils and dinar. The student solve exercises related to the exchange of fils to dinars. It also include add/subtract 4-place number with/without renaming (99999). Word problems also presented.		
22. Geometry.	101-102	3
These pages concern two types of lines parallel and intersect. Student solve verbal questions that recognize: rays, parallel..etc		

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
23. Measurement (metric units).	103-105	3

These pages emphasize the standard units. The students measure lengths of line segment. The new concept presented in these pages is that the centimeter is a standard unit of metric measurement.

24. General practice.	106	1

The students solve variety of exercises which included: add 5-place value # with 3- and 4-place value #s. Moreover, multistep word problems also presented.

25. Multiply by 10, 100 & 1,000.	107	1

Numeration, place value, and expanded notation are reviewed at this page. The extension to millions provided difficulty. The procedure is look like the following:

(a) Equation method:

```
3 X 40 = 3 X (4 X 10)  Rename 40 as 4X10
       = (3X4) X  10   Use associative property.
       = 12    X  10   Rename 3X4 as 12
       = 120           Rename 12X10 as 120
```

(b) Four step method:

```
 324
X  3
-----

  12   3   times   4  =  12
  60   3   times  20  =  60
 900   3   times 300  = 900
-----

 972     900 + 60 + 12 = 972
```

26. General practice.	108	1

The students solve variety of exercises which included: Multiply 3-place value # with 1- and 2-place value #s. Moreover, multistep word

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
problems also presented.		
27. Divide by 10, 100 & 1,000.	109-110	2
Numeration, place value, and expanded notation are reviewed at these pages. Page 109 is designed to give students practice in dividing with 10, 100, and ,1000 with/ without renaming. E.g., 400-10=390		
28. Multiply by tens.	111	1
On this page the emphasis is on the multiplication by ten with with renaming. Students solve some multisteps word problems involving money.		
29. Money.	112-114	3
No new concept is introduced. Exercises include the exchange from dinar to fils.		
30. Addition/subtraction of money.	114-118	5
The new concept is used in these pages involved addition/subtraction of money. Identify the place value in addition/ subtraction. E.g., "1000 can be taught as the value of one dinar. Word problems also included. The work procedure is as follow:		

Dinars	Fils	Dinars	Fils
142	300	142	1300
- 98	700	98	700
?	?	43	600

31. Multiply 2-place value #s with 1-place value with renaming.	119-121	3
The new concept is used in these pages is multiply 2-place value #s with 1-place value		

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
#s with renaming. The students practiced the distributive property with respect to addition (vertical and horizontal forms) 4X12 = 4X(2+10) = 48 The most significant concept to students is to understand that one of the factor in each of these multiplication involves a sum.		
32. General practice. Students solve multiplication problems (horizontal & vertical). Word problems also presented involving money multiplication computations.	122	1
33. Multiply 3-place value #s with 1-place number with renaming. The new concept is used in these pages is multiply 2-place value #s with 1-place value #s with renaming. The students practiced the distributive property with respect to addition (vertical and horizontal forms) 134 X 2 = 100 + 30 + 4 X 2 200 + 60 + 4 = 268 The most significant concept to students is to understand that one of the factor in each of these multiplication involves a sum.	119-121	3
34. General practice. Students solve multiplication problems (horizontal & vertical forms). Word problems also presented involving money multiplication computations.	124	1
35. Divide 2- place #s and 3-place #s with renaming.	125	1

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
The new concept introduces in a word problem form. Students work to the final solution of the problem.		
36. General practice.	126	1
Students solve (horizontal & vertical forms). Word problems also presented involving money division computations.		
37. Divide 2-place #s with 1-place # with renaming.	127	1
This page emphasize that the division and multiplication are opposite operations. The students practiced some exercises such as: (5 X 7) = 35, (35 ÷ 7) = 5.		
38. Divide with remainder.	128-129	2
On these pages the concept of division with remainder is introduced. First with sets and then with numbers. The difficulty for the students is that this kind of division involves 2 operations; multiplication and division. E.g., 16 ÷ 3 = (3 X 5) + 1. In some sequences, division with remainder is taught much later than division without remainder.		
39. Divide 2- and 3-place # with 1-place with renaming.	130-131	2
The new concept introduces in a word problem form. Students work to the final solution of the problem.		
40. General practice.	132	1
Students solve division problems (horizontal & vertical forms). Word problems also presented involving money division computations.		

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
41. Year calendar.	140 141	2
These pages concern the recognition of a year consists of 12 months. Moreover, and how many days in one month (Arabic).		
42. Measurement metric: Weight.	142	1
These pages concern a new concept: metric weight unit and its notation: grams, kilograms. The students work is as follow: 2 Kgs = ? grams.		
43. General practice.	143	1
Students solve problems (horizontal & vertical). Word problems also presented involving all computational skills.		
GRADE 4		
1. Sets.	11-25	15
These pages revise set concepts that were covered in the previous grades 1-3: The exercises emphasized on elements of as set, belong, subsets, joining of two sets, and intersection of two sets. These concepts also deal with all computational skills.		
2. Whole numbers.	29-47	18
a. Divide with 2 & 5 as factors.	29-30	2
The new concepts presented on these two pages are that of extending division facts with 2 & 5 as factors. These concepts are based on work previously introduced in the grades 1-3. Students practiced some exercises involving these two factors.		
b. Odd and even numbers.	31-32	2

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
The new concepts presented on these two pages are that odd and even numbers. These concepts are based on: (a) An odd number cannot be divided evenly by 2. Generally stated that the numbers are the set of all number b such that b=(2Xn)+1. (b) An even number has 2 as a factor. Generally stated the even numbers are the set of all numbers a such that a=2Xn, where n is any whole number. Student practiced some exercises involved this new concept. E.g., "Name the 6 even and odd numbers between 90 and 102".		
c. Divide with as factor.	32-33	2
The new concepts presented on these two pages are that of extending division facts with 3 as factor. The number that could be divided by 3 without remainder is that the of its digits divided by 3. This concept is based on work previously introduced in the grades 1-3. Students practiced some exercises involving this factor.		
d. General practice.	38-40	3
Students solve exercises and problems (horizontal & vertical). These exercises include: odd and even numbers, divide with 2, 3 # 5 as factors. Also includes factors of an integers whose product with some integers is the given integer. E.g., "3 and 4 are factors of 12, since 3 X 4 = 12.		
e. Greatest Common Factor.	38-40	3
The new concept presented on these two pages is that of greatest common factor. The common factors of 30 and 42 are 2,3 & 6. The G.C.F. for these two integers is 6. Students solve some exercises involved this concept. E.g., "Name the common factor of 25 & 35".		

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
f. Least Common Multiple.	41-43	3
The new concept presented on these two pages is that of Least Common Multiple. The L.C.M. is divisible by each of the given quantities: 12 is L.C.M. of 2, 3, 4, & 6. Students solve exercises involving this concept. E.,g., " Find L.C.M. for 10, 12, 30".		
g. Read/write whole numbers to millions.	44-47	4
The new concept presented on these pages is that of read/write whole numbers to millions. In these pages students recognize and compare that millions place is seventh from right. These pages extend place value and numeration to millions. Students practice this concept by writing and reading. E.g., " Identify the place value of a given number in the 7th place two two thousands".		
7. Add/subtract 9-place #s with 9-place #s.	51-52	2
These pages extend place value and numeration to millions. Students practice some exercises in adding and subtracting 9-place #s. E.g.,		
6,260,346 + 1,946,827 8,207,173.		
8. Multiply 1-place value #s with 2- and 3-place number with/without renaming.	52-58	3
These pages presented no new mathematical concept, rather revising this concept from previous grade (3). The student s practiced the multiplication with respect to this concept (vertical and horizontal forms). E.g., " 15 X2 = 30, 224 X 5 = 1,120".		
9. Multiply 2-place value #s with 3-place number with/without renaming.	59-61	3

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
These pages presented no new mathematical concept, rather revising this concept from previous grade (3). The students practiced the multiplication with respect to this concept (vertical and horizontal forms). E.g., " 24 X 26 = 624". Word problems also presented involving computational skills.		
10. Divide 2-and 3-place value #s with 1-place number with/without renaming.	61-68	8
These pages presented no new mathematical concept, rather revising this concept from previous grade (3). The students practiced the multiplication with respect to this concept (vertical and horizontal forms). E.g., "Hundreds Tens Ones 1 1 2 3 ⟌ 3 3 6 - 3 0 3 6 - 3 0 6 - 6 0 0 0. Word problems also presented involving computational skills.		
11. Divide 2-and value #s with 1-place number with/without renaming.	68-69	2
These pages presented no new mathematical concept, with respect to the division algorithms. The students practiced the division algorithms with respect to this concept (vertical and horizontal forms). E.g., 68 ÷ 17 = 4 ———> 17 X 4 = 68. Emphasis on the multiplication and division are inverse operations.		

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
12. General practice.	69-70	2
Students solve problems (vertical and horizontal forms). Word problems also involving long form division.		
13. Fraction numbers:	73-99	26
a. Comparison and equivalent.	73-79	6
These pages revise some fraction concepts: Comaprison & equivalent in the previous grades 1-3. The exercises emphasized on these two concepts. "e.g., 1/2 = 2/4...etc".		
b. Compare fractions with like denominators.	79-80	2
The new concept introduced here is the comparison of traditional #s for order & inequality (<,>). Student solve exercises involved the comparison of fractions with like denominators. E.g., "1/4 < 3/4".		
c. Compare fractions with like numerators.	81-82	2
The new concept introduced here is the comparison of traditional #s for order & inequality (<,>). Student solve exercises involved the comparison of fractions with like numerators. E.g., "2/3 > 2/4".		
d. Reduce to simplest form.	83-84	2
The new concept introduced here is the reduction of traditional #s for simplest form. Student solve exercises involved the reduction of fractions to simplest form. E.g., " 6/8 = 6/2/8/2 = 3/4".		
e. Add/subtract fractions with like denominators.	85-89	5
The new concept introduced here is the addition and subtraction of fractions #s with like denominators. Student solve exercises involved the addition and		

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
subtraction fractions with like denominators. E.g., " 3/8 + 1/8 =, 9/10 - 8/10".		
f. Mixed numbers form.	90-91	2
The new concept introduced here is the mixed numbers forms. Student solve exercises involved the identification of mixed #s. E.g., "2 1/2 is a mixed #".		
g. Transform mixed numbers to uncommon fractions.	92-93	2
The new concept introduced here is the transformation of mixed #s to uncommon fractions. Student solve exercises involved the transformation of mixed #s to uncommon fractions. E.g., "3 = 3/1, 1 = 6/2 = 9/3...".		
h. General practice.	94-95	2
Students solve problems (vertical and horizontal forms). Word problems also presneted.		
j. Add/subtract mixed #s with like denominators.	96-97	2
The new concept introduced here is the addition and subtraction of mixed #s with like denominators. Student solve exercises involved the addition and subtraction of mixed #s with like denominators. E.g., " With Ali 3 1/4 dinars With Amal 5 3/4 dinars How many dinars the both have? "3 1/4 + 5 3/4 = = 8 4/4 = 9". "5 3/4 - 3 1/4 = 2 2/4 = 2 1/2".		
k. General practice.	98-99	2

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
Students solve problems (vertical and horizontal forms). Word problems also presneted.		
14. Decimal numbers:	100-116	18
a. One tenth.	100-103	4
In these pages the decimal number one tenth is introduced as follows: (a) renaming common fractions like 5/10 form to 5 tenth, (b) the decimal comma (in American textbook is decimal point) used in writing decimal form number. Students work with exercises to identify decimal fractions. E.g., "Compare the sequence of deciaml fractions as shown in a given example: 3.7 3.9 3.8 —— .9 ——". Word prblems also introduced.		
b. One hundredth.	104-105	2
In these pages the decimal number one hunderdth is introduced as follows: (a) renaming common fractions like 50/100 form to 5 hundredth, (b) the decimal comma (in American textbook is decimal point) used in writing decimal form number. Students work with exercises to identify decimal fractions. E.g., "Compare the sequence of deciaml fractions as shown in a given example: 3.70 3.90 3.80 —— .90 ——". Word prblems also introduced.		
c. General practice.	106-107	2
Students solve problems (Horizontal and vertical forms). E.g., "What is goes in □ <, > "or" = 35.70 □ 32.90".Word problems presented.		

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
d. One thousandth.	107-108	2
In these pages the decimal number one thousandth is introduced as follows: (a) renaming common fractions like 500/1000 form to 5 thousandth, (b) the decimal comma (in American textbook is decimal point) used in writing decimal form number. Students work with exercises to identify decimal fractions. E.g., "Compare the sequence of deciaml fractions as shown in a given example: 3.700 3.900 3.800 ——— .900 ———". "Read/write 3.425". Word prblems also introduced.		
e. Genral practice.	109-110	2
Students solve problems (Horizontal and vertical forms). E.g., "Add the folloswing fractions 2 + 0/10 + 5/100 + 9/1000 = 2.059. Word problems presented.		
f. Add/subtract deciamls #s.	111-114	4
In these pages the students comprehend the addition and subtraction computations involving deciamls #s with/without regrouping and renaming (vertical and horizontal froms). E.g., " 12.37 + 4.25 = 16.89" "3.850 - 1.673 = ?" Word problems presented.		
g. Genral practice.	115-116	2
Students solve problems (Horizontal and vertical forms). E.g., "Add the folloswing fractions 2 + 0/10 + 5/100 + 9/1000 = 2.059. "25.227 - 14.089 = ". Word problems presented.		
15. Geometry (Nonmetric & Metric).	134-162	27
In these pages the nonmetric geometry presented: (a) students use the notations symbols of line, ray,		

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
angle and line segment and (b) compare types of angles and lines. 3-dimensional figures also included. The metric geometry includes: measure & draw angles measure and calculate circumferences of some shapes: traingle, square. Identify symmetry property, and know area concept.		
16. Measurement.	119-140	20
a. Time	119-123	5
These pages concern: (a) read/write time in hour, 1/2 hour, and minutes. E.g., "Quarter past four written as 4:15". (b) read/write time in days/week. E.g., "28 days in 4 weeks, how many in 1 week". Word problems presented.		
b. Addition/subtraction time notations with/without renaming.	124-127	4
In these pages a new concept introduced: (a) Addition of hours and minutes. E.g., "Hours Minutes" 7 10 + 5 25 = 12 35". (b) Subtraction procedure of hours and minutes. E.g., "Hours Minutes" 9 25 - 7 10 = 2 15". Word problems presented.		
c. Lenght.	129-132	4
These pages concern the new concept: Meter, centimeter, decimeter, melimeter.. The symbols were used when students work with addition and subtraction of metric units.		

(CHART CONTINUED).

Curriculum objectives/ textbook coverage	Page #	# of lessons
d. Add/subtract metric lenght.	133-135	3

A new concept introduced here. Addition of metric units. E.g., "Add the following:

ms	cms
20	45
14	20
+ 32	35
66	100 (100 cms = 1 m).
67	——."

ms	cms
20	50
- 12	70
7	80".

e. Weight.	136-137	2

These pages concern the new concept: Grams, kilograms, and tons. The symbold were used when students work with addition and subtraction metric weight units. A new concept introduced here. Addition of metric weight units. E.g., "Add the following:

kgs	grs
19	500
+ 16	750
35	1250 (100 grs = 1 kg).
36	250."

kgs	grs
25	300
- 13	800
11	800".

f. General practice.	139-140	2

Students solve problems (horizontal & vertical forms) involving measurement concept. Word problems presented.

APPENDIX D

TEST BOOKLETS (GRADE 1-4)
ARABIC VERSION
ENGLISH VERSION

APPENDIX D

TEST BOOKLETS (GRADE 1-4)
(ARABIC VERSION)

اسم المدرسة : _____

اسم التلميذ/ التلميذة : _____

☐ تلميذ ☐ تلميذة

العمر : ☐٦ ☐٧ ☐٨ ☐٩

الصف : ☐١ ☐٢ ☐٣ ☐٤

☐ نظام عادي ☐ نظام فصل

المدرس : ☐ ذكر ☐ أنثى

☐ مدرس عادي ☐ مدرس فصل

APPENDIX D

TEST BOOKLETS: (GRADE 1)
(ARABIC VERSION)

اسم المدرسة : _____

اسم التلميذ/ التلميذة : _____

☐ تلميذ ☐ تلميذة

العمر : ٦ ٧ ٨ ٩

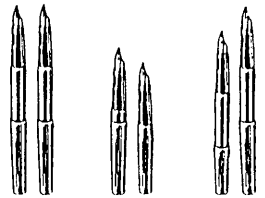
الصف : ١ ٢ ٣ ٤

☐ نظام عادي ☐ نظام فصل

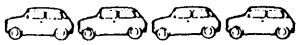
الجنس : ☐ ذكر ☐ أنثى

☐ مدرس عادي ☐ مدرس فصل

٥ ـ ضع علامة ✓ تحت الاقلام المتساوية في الطول :



٦ ـ لون السيارة الثالثة بما يأتي :



٧ ـ ضع علامة ✓ تحت الفاكهة التي تكمل الشكل التالي :



٨ ـ لون الوزة الثانية التي على يمين السلة :

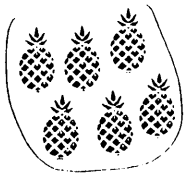


تمييز الاعداد

٩ ـ ضع علامة ✓ تحت المجموعة التي تحتوي على ٤ عناصر :

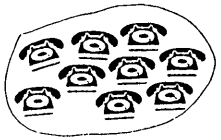


١٠ ـ ضع علامة ✓ امام العدد الصحيح للمجموعة التالية :



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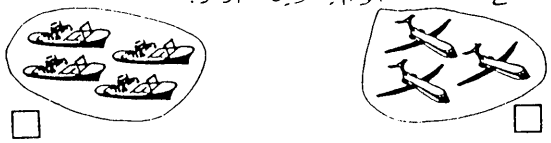
١١ ـ ضع علامة ✓ امام العدد الصحيح للمجموعة التالية :



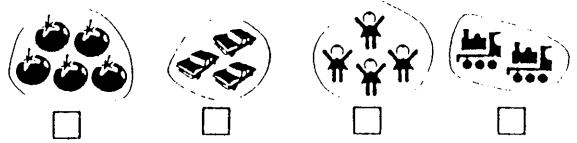
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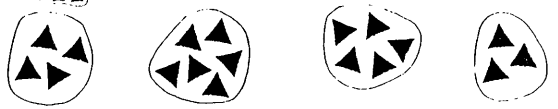
١٢ ـ ضع علامة ✓ تحت المجموعة التي تحتوي على عناصر أكثر :



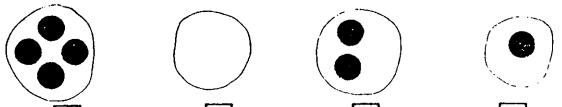
١٢ - ضع علامة ✓ تحت المجموعة التي تشابه المجموعة التي تراها (●●●)



١٤ - ضع علامة ✓ تحت المجموعة التي تزيد بواحد عن المجموعة التي تراها (▲▲▲)

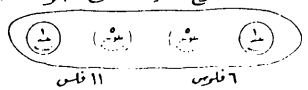


١٥ - ضع علامة ✓ تحت المجموعة التي تقل بواحد عن المجموعة التي تراها (●●)



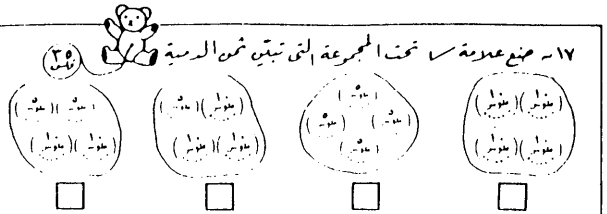
النقود

١٦ - ضع علامة ✓ تحت المجموع الكلي الصحيح للمجموعة الآتية :



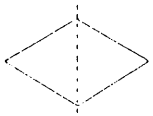
١٢ فلس | ٦ فلوس | ١١ فلس | ٧ فلوس

١٧ - ضع علامة ✓ تحت المجموعة التي تبين ثمن الدمية (٣٥ فلس)



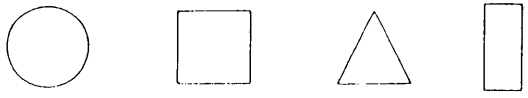
الهندسة

١٨ - اذا ثنيت هذا الشكل هل يتطابق الجزءان ؟

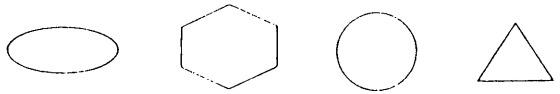


نعم | لا

١٩ - ضع علامة ✓ تحت ◯ من الأشكال التالية :



٢٠ - ضع علامة ✓ تحت △ من الأشكال التالية :



APPENDIX D

TEST BOOKLETS: (GRADE 2)
(ARABIC VERSION)

٧- ضع علامة ✓ تحت الرقم الذي يأتي بعد الأرقام التالية:

٨١ ، ٨٢ ، ٨٣ ، ____

٨٥	٨٠	٨٤	٨٦
☐	☐	☐	☐

٨- ضع علامة ✓ تحت أكبر عدد من الأعداد التالية:

٤٣٥	٣٥٤	٥٣٤	٥٤٣
☐	☐	☐	☐

٩- ضع علامة ✓ تحت الرمز المناسب للجملة التالية:

٨٣ أكبر من ٣٨

>	<	=
☐	☐	☐

عمليات على الأعداد (+ ، −)

١٠- ضع علامة ✓ تحت ناتج العملية الحسابية في العبارة الآتية:

$$\begin{array}{r} ٥ \\ +\ ٧ \\ \hline \_\_\_\_\_ \end{array}$$

٦	٢١	١٢	١٣
☐	☐	☐	☐

١١-

٨ + ٠ = ____

٨	٧	١٢	٠
☐	☐	☐	☐

١٢-

$$\begin{array}{r} ١٨ \\ -\ ٩ \\ \hline \_\_\_\_\_ \end{array}$$

٩	٨	٧	٦
☐	☐	☐	☐

١٣-

١٠ − ١٠ = ___

١٠٠	١٠١	٠	١٠
☐	☐	☐	☐

حواريبية الجمع والطرح (+ ، −)

ضع علامة ✓ تحت ناتج العملية الحسابية في العبارة التالية

١٤-

٦ + ٣ + ٢ = ___

١١	٢٣٦	٢٩	٥٦
☐	☐	☐	☐

١٥-

$$\begin{array}{r} ٧٥ \\ +\ ٣٢ \\ \hline \_\_\_\_ \end{array}$$

٨٩	٤٣	١٠٧	٤٧
☐	☐	☐	☐

١٦-

$$\begin{array}{r} ٥١٤ \\ -\ ٢١٣ \\ \hline \_\_\_\_\_ \end{array}$$

٧٢٧	٣٠١	٣٢٧	٥٢٧
☐	☐	☐	☐

١٧-

$$\begin{array}{r} ٣٠٧ \\ +\ ٢٥١ \\ \hline \_\_\_\_ \end{array}$$

٥٥٥	٥٥٨	٥٥٦	٥٥٧
☐	☐	☐	☐

١٨-

$$\begin{array}{r} ٨٧ \\ -\ ٤٩ \\ \hline \_\_\_\_ \end{array}$$

٣٨	٤٨	٤٦	١٢٦
☐	☐	☐	☐

عمليات الضرب (×)

ضع علامة ✓ تحت الناتج الصحيح من عمليتي الحساب الآتيتين:

١١-

٢ × ٤ = ----

٦ ٨ ٤ ٢

١٢- ضع علامة ✓ تحت القيمة الكلية للنقود التالية:



٢٧٥ ٢٥٠ ٢٧٠ ٢٢٥

١٣- ضع علامة ✓ تحت الوقت الصحيح الذي تشير إليه الساعة المرسومة أمامك



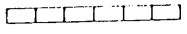
الساعة الثانية والربع | الساعة الثانية تمامًا | الساعة الثانية وخمس دقائق | الساعة الثانية إلا ربع

١٤- ضع علامة ✓ تحت الوقت الذي تشير إليه الساعة المرسومة أمامك:



الساعة الثامنة والنصف | الساعة الثامنة تمامًا | الساعة الثامنة إلا ربعًا | الساعة العاشرة والنصف

١٥- ضع علامة ✓ تحت طول الشريط الموضح أمامك (استخدم المسطرة):



٧سم ٥سم ٤سم ٦سم

١٦- ٥
٣ ×

---

١٥ ٨ ٢٠ ١٠

[الهندسة]

١٧- ضع علامة ✓ تحت المستطيل من الأشكال التالية:



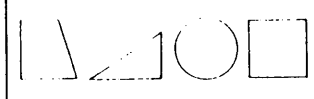
١٨- ضع علامة ✓ تحت الشكلين المتشابهين من الأشكال التالية:



١ ٢ ٣ ٤

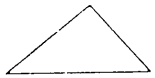
١ر٢ ٢ر٣ ١ر٣ ١ر٤

١٩- ضع علامة ✓ تحت المربع من الأشكال التالية:



١ ٢ ٣ ٤

٢٠- ضع علامة ✓ تحت عدد الأضلاع للشكل المرسوم:



٤ ٣ ٢ ١

[حل المسألة]

٢١- اقرأ ما يأتي:

في الصف الأول ٢٧ تلميذًا

في الصف الثاني ٢٦ تلميذًا

في الصفين معًا [ ] تلميذًا

ضع علامة ✓ تحت الناتج الصحيح:

٦٣ ٧٣ ٦١ ٧٢

٢٢- اقرأ ما يأتي:

عند فاطمة ٩

عند عيسى ١٨

ضع علامة ✓ تحت العدد الصحيح الذي يمثل الفرق بين ألوان عيسى وفاطمة معًا:

٩ ٨ ٢٧ ١٠

APPENDIX D

TEST BOOKLETS: (GRADE 3)
(ARABIC VERSION)

اسم المدرسة : _____

اسم التلميذ/ التلميذة : _____

☐ تلميذ ☐ تلميذة

العمر : ☐ ٦ ☐ ٧ ☐ ٨ ☐ ٩ ☐ ٤

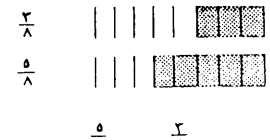
الصف : ☐ ١ ☐ ٢ ☐ ٣ ☐ ٤

☐ نظام عادي ☐ نظام فصل

الدرس : ☐ ذكر ☐ أنثى

☐ مدرس عادي ☐ مدرس فصل

٧- ضع علامة ✓ تحت الكسر الأكبر



٣/٨	٥/٨
☐	☐

٨- $\frac{1}{2}$ الـ ٢٠ =

ضع علامة ✓ تحت الإجابة الصحيحة مما يأتي:

١٠	٥	٤٠	٢
☐	☐	☐	☐

٩- عمليات الجمع والطرح

ضع علامة ✓ تحت العدد الصحيح للعمليات الآتية فيما يلي:

$\frac{٩٠}{\dots\dots}$

٠	١٨	١٧	١٩
☐	☐	☐	☐

١٠- $\frac{١٣}{٥-}$

٨	٥	٧	٩
☐	☐	☐	☐

١١- ٨ + ٠ = ...

٨٠	٠	٨	١
☐	☐	☐	☐

١٢- ١٦ - ٧ = ...

٨	٧	٩	١١
☐	☐	☐	☐

عمليات الضرب والقسمة (× ، ÷)

١٣- ضع علامة ✓ تحت العدد الصحيح للعمليات الحسابية التالية:

٨ × ٥ = ...

٤٠	١٣	٣٥	٤٥
☐	☐	☐	☐

١٤- ٣٥ ÷ ٥ = ...

٥	٦	٧	٨
☐	☐	☐	☐

١٥- $\frac{٩}{٦\times}$

٥٤	٤٥	١٥	٤٩
☐	☐	☐	☐

١٦- ٦ ÷ ٠ = ...

١	٦	٦٠
☐	☐	☐

١٧- ضع علامة ✓ تحت العدد الصحيح للعمليات الحسابية التالية:

$\begin{array}{r} ١٢٧٤ \\ +\ ١١٣٥ \end{array}$

٢٤٠٩	٢٣٧٩	٢١٤٩	٢٣٠٩
☐	☐	☐	☐

١٨- $\begin{array}{r} ٥٣٤ \\ -\ ٢٣٩ \end{array}$

٣٠٥	٣٩٥	٢٦٥	٢٩٥
☐	☐	☐	☐

١٩-

١٠٠
× ١٢

١٢٠ | ١٢٠٠ | ١٢٢٠٠ | ١٠٠٢

٢٠-

٧٠ ÷ ٦ =

١٠ | ١٠ والباقى ٤ | ١١ والباقى ٤ | ١١

٢١-

صع علامة ✓ تحت العدد التقريبى للعملية الحسابية التالية :

٣١٠ × ٣ = ...

٩٠٠ | ٩٠ | ٩٠٠٠ | ١٠٠٠

٢٢-

القياس

صع علامة ✓ تحت القيمة الصحيحة من فئة القياس المناسبة التالى :

٥ سنتيمتر

٥٠٠ فاس | ٥٠٠٠ فلس | ٥٠٠٠٠ فلس | ٢٥٠٠٠ فاس

٢٣-

صع علامة ✓ تحت الوقت الذى تشير اليه الساعة المرسومة أمامك :



الثامنة الا ربعا | الثالثة والربع | الثامنة والربع | الثالثة الا ربعا

٢٤

صع علامة ✓ تحت القيمة المحيحة بالكيلوجرام للوزن التالى :

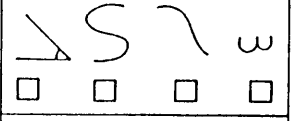
١٥٠٠٠ جرام

١٥٠ كجم | ١٥ كجم | ١٥٠٠ كجم | ٥ كجم

٢٥-

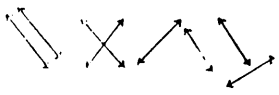
الهندسة

صع علامة ✓ تحت الزاوية من الأشكال التالية :



٢٦-

صع علامة ✓ تحت المستقيمين المتوازيين من المستقيمات التالية :



٢٧-

أقرأ ما يأتى :

فى الأسبوع سبعة أيام . كم يوما فى ٣ أسابيع ؟

صع علامة ✓ تحت الحل الصحيح لهذه الأيام فى المسألة السابقة :

١٤٧ | ١٧٤ | ٣ | ٢٨

٢٨-

اقرأ ما يأتى :

وزع أحمد ٢٥ قطعة حلوى على ٥ علب فكم قطعة وضعها فى علبة ؟

صع علامة ✓ تحت الحل الصحيح لهذه المسألة :

٣٠ | ٥ | ٢٠ | ١٢٥

٢٩-

أ) أتأمل :

	فلس	دينار
مع حسين	٣٠٠	٤
مع فاطمة	٧٠٠	٢
مع باسم	١٠٠	٥
مجموع ما مع الثلاثة	.....	.....

صع علامة ✓ تحت المجموع الصحيح فى المسألة السابقة مما يأتى :

٣٠-

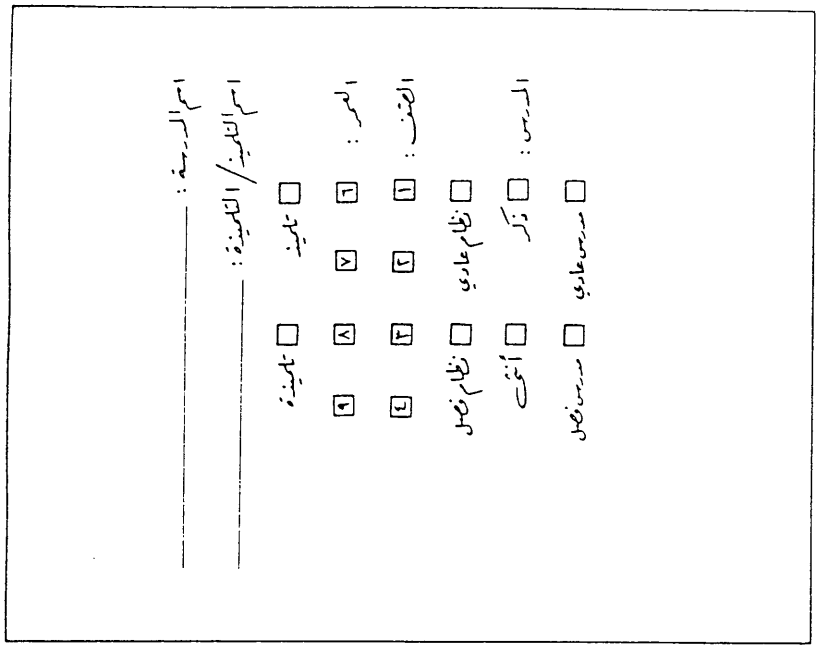
أ) أتأمل :

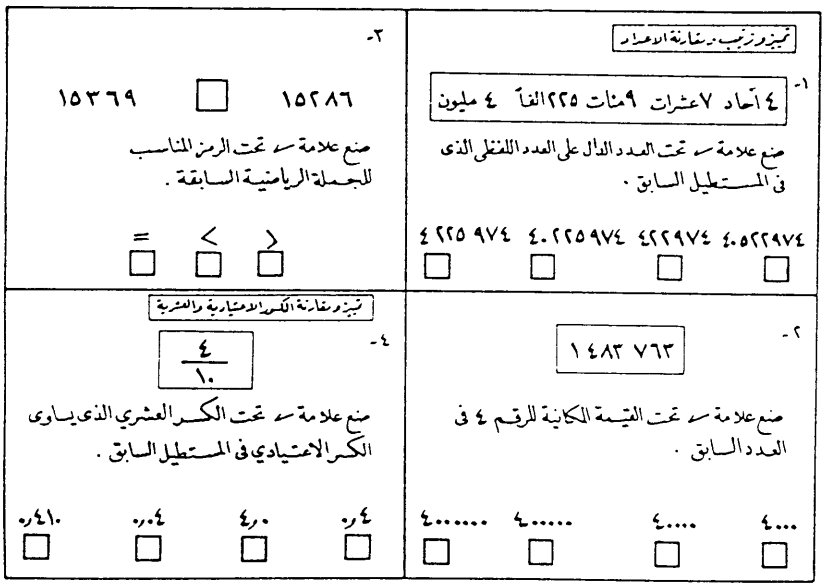
مع أمال	٣٠٠	٢٨
مع منى	٢٠٠	١٤
الباقى	.....	.....

صع علامة ✓ تحت الباقى الصحيح من المسألة السابقة مما يأتى :

APPENDIX D

TEST BOOKLETS: (GRADE 4)
(ARABIC VERSION)





٥- ضع علامة ✓ تحت الكسر الذى يكافئ الكسور التالية :-

$\frac{٢}{٤}$ ، $\frac{٤}{٨}$ ، $\frac{٦}{١٢}$ ...

$\frac{٨}{١٦}$	$\frac{٩}{٢٠}$	$\frac{٧}{١٥}$	$\frac{١٠}{٢١}$
☐	☐	☐	☐

٦- ضع علامة ✓ تحت الكسر الذى يساوى صفراً مما يأتى :-

$\frac{٦}{٦}$	$\frac{١}{٦}$	$\frac{٠}{٦}$	$\frac{٩}{٦}$
☐	☐	☐	☐

عمليات + ، - ، × ، ÷

٧- ٩ + ٨ = ١٧
٨ + ٩ = ١٧
٩ = ٨ - ١٧
.....

ضع علامة ✓ تحت المعادلة الحسابية التى تنتمى الى مجموعة الحقائق السابقة :-

١٧ - ٩ = ٨	٩ + ٨ = ١٧	٩ - ٨ = ١٧	١٧ + ٩ = ٨
☐	☐	☐	☐

٨- ٣٠ = ٥ × ٦
٣٠ = ٦ × ٥
٣٠ ÷ ٥ = ٦
.....

ضع علامة ✓ تحت المعادلة الحسابية التى تنتمى الى مجموعة الحقائق السابقة :-

٣٠ × ٥ = ٦	٣٠ ÷ ٦ = ٥	٦ × ٣٠ = ٥	٦ ÷ ٥ = ٣٠
☐	☐	☐	☐

خوارزميات + ، - ، × ، ÷

٩- ٨٣٦٥
٥٣٧٥ -
٢٩٩٠

ضع علامة ✓ تحت العملية الحسابية الصحيحة التى تؤكد صحة المسألة الحسابية السابقة .

٥٣٧٥ - ٨٣٦٥	٥٣٧٥ + ٢٩٩٠	٥٣٧٥ - ٢٩٩٠	٨٣٦٥ + ٢٩٩٠
☐	☐	☐	☐

١١-

٤) ٤٨٤

١٢١	١١٢	١٢٢	١٤١
☐	☐	☐	☐

١٠- ضع علامة ✓ تحت ناتج كل عملية حسابية مما يأتى :-

٤٩٢
× ٢٠٠
.....

٩٨ ٤٠٠	٨٤٠ ٩	٩٨ ٤٢٢	٨١٨ ٤٠٠
☐	☐	☐	☐

عمليات على الكسور

١٢- ضع علامة ✓ تحت ناتج كل عملية حسابية مما يأتى :-

$\frac{٤}{٥} + \frac{٣}{٥} = ...$

$\frac{٧}{١٠}$	$\frac{٧}{٥}$	$\frac{١}{٥}$	٢
☐	☐	☐	☐

١٣- $٢\frac{٢}{٣} - ١\frac{١}{٣} = \ldots\ldots$

☐ $٣\frac{٢}{٣}$ ☐ $١\frac{١}{٣}$ ☐ $٣\frac{٢}{٥}$ ☐ $١\frac{٣}{٥}$

١٥- ضع علامة ← تحت طول المستقيم الموضح أمامك أستخدم المسطرة .



☐ ٨,٠سم ☐ ٨,٥سم ☐ ٧,٥سم ☐ ٩سم

القياس

١٤- ٥ أسابيع و ٤ أيام

ضع علامة ← تحت الاجابة الصحيحة لمجموع عدد الأيام الكلية فى المستطيل السابق .

☐ ٢٨يوماً ☐ ٢٩يوماً ☐ ٢٨ يوماً ☐ ٣٩ يوماً

١٦- تذكران

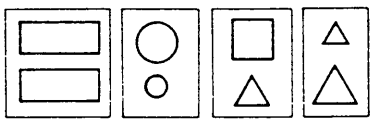
١ طن = ١٠٠٠ كيلوجرام
١ كيلوجرام = ١٠٠٠ جرام

ضع علامة ← تحت الاجابة بالجرام بقيمة $\frac{١}{٤}$ طن و ٣ كيلوجرامات مما يأتى :-

☐ ٣٠٥٠٠٠جم ☐ ٥٣٠٠٠٠جم ☐ ٥٠٣٠٠٠جم ☐ ٣٥٠٠٠٠جم

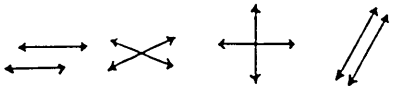
الهندسة

١٧- ضع علامة ← تحت الشكلين المتطابقين تماماً من الاشكال التالية :-



☐ ☐ ☐ ☐

١٨- ضع علامة ← تحت المستقيمين المتعامدين من المستقيمات التالية :-



☐ ☐ ☐ ☐

مسائل لفظية

١٩- اقرأ ما يأتى :
وزن أحمد ٤٦,٥٠ كجم
وزن فاطمة ٤٠,٧٥ كجم
ضع علامة ← تحت الوزن الصحيح الذى يبين الفرق بين وزن أحمد ووزن فاطمة .

☐ ٧,٥٥كجم ☐ ٥,٧٥ كجم ☐ ٥,٧٠ كجم ☐ ٧,٥٠ كجم

٢٠- اقرأ ما يأتى :
إشترت بدور فستاناً بمبلغ ٦ دنانير و ٧٥٠ فلساً ومعطفاً بمبلغ ٨ دنانير و ٩٥٠ فلساً . فكم المبلغ الكلى الذى صرفته بدور فى شراء الفستان والمعطف .

ضع علامة ← تحت المبلغ الكلى لثمن الفستان والمعطف

☐ ١٥ديناراً ☐ ١٥ديناراً و٧٠٠فلساً ☐ ١٥ديناراً و٩٠٠ فلساً ☐ ١٥ديناراً و٧٥٠ فلساً

APPENDIX D

TEST BOOKLETS: (GRADE 1-4)
(ENGLISH VERSION)

Name of School: _____

Name of Student: _____

Student Gender : Male Female

Age: 6 7 8 9

Grade in School: 1 2 3 4

Teacher Gender : Male Female

Classroom Organizational Structure:

Departmentalization

Self-Contained

APPENDIX D

TEST BOOKLETS: (GRADE 1)
(ENGLISH VERSION)

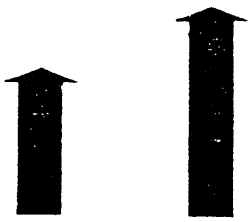
[PLACE AND SIZE RELATIONSHIPS]

1. Which wheat is taller?



☐ ☐

2. Which arrow is shorter?



☐ ☐

Item 1. G1 n=822 a)9 b)780 c)0 d)0 e)33 f)42, 95%, 1/20.

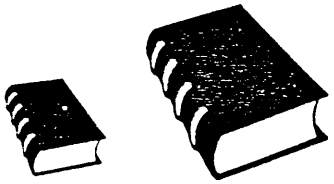
Item 2. A, G1 n=822 a)13 b)737 c)0 d)0 e)71 f)85, 90%, 5/20.

3. Which camel is larger?



☐ ☐

4. Which book is smaller?

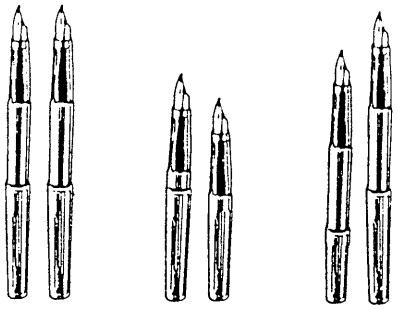


☐ ☐

Item 3. A G1 n=822 a)6 b)714 c)0 d)0 e)48 f) 54, 93%, 2/20.

Item 4. A G1 n=822 a)10 b)761 c)0 d)0 e)51 f)61, 93%, 3/20.

5. Which two are the same length?



☐ ☐ ☐

6. Color the third car.



Item 5. A G1 n=822 a)11 b)2 c)719 d)0 e)90 f)103 93%, 8/20.

Item 6. MA, G1 n=822 a)22 b) 183 c)569 d)7 e)41 f)253, 69%, 15/20

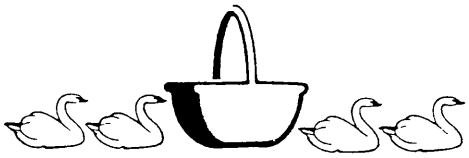
7. Look at the pattern. Which fruit should come next?





☐ ☐

8. Color the second swan which is on the right of the basket.

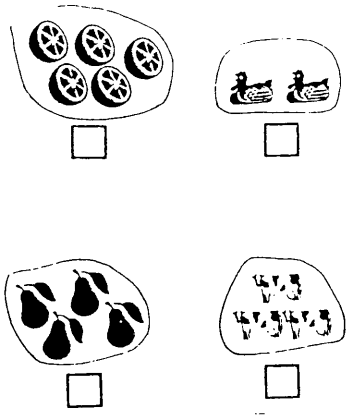


Item 7. A G1 n=822 a)637 b)91 c)0 d)0 e)93 f)185, 77%, 13/20

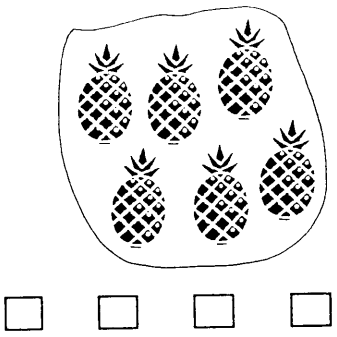
Item 8 MA, G1 a) 102 b) 557 c) 39 d) 72 e) 52 f) 720, 12%, 20/20

[NUMBER RECOGNITION]

9. Which set has 4 ?



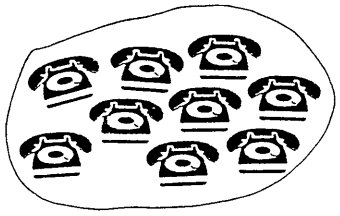
10. How many?



Item 9. A, G1 n=822 a)5 b)747 c)5 d)3 e)62 f)75, 91%, 4/20.

Item 10. n=822 a)8 b) 2 c) 722 d) 7 e) 83 f) 100 88%, 7/20.

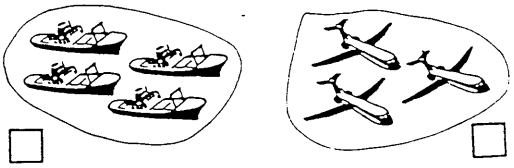
11. How many?



8 6 7 9

[NUMBER RECOGNITION]

12. Which set has more?

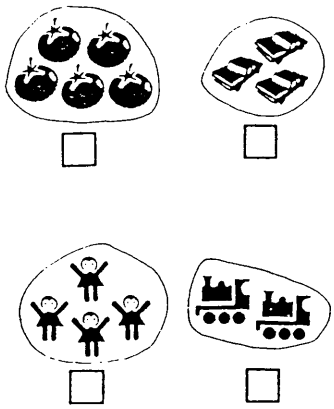


Item 11. A, G1 n=822 a)18 b)4 c)4 d)698 e)98 f)124, 85%, 11/20.

Item 12. A, G1 n=822 a)25 b)728 c)2 d) 0 e) 69 f)94, 89%, 6/20.

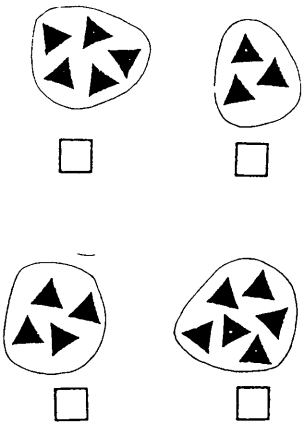
13. Which set has the same number as this set?





14. Which set has one more than this set?



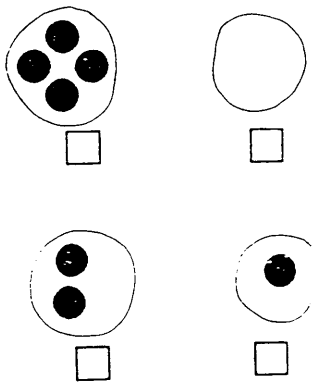


Item 13. A, G1 n=822 a)18 b)28 c)646 d)31 e)99 f)176, 79%, 12/20.

Item 14. MA, G1 n=822 a)14 b)126 c)471 d) 30 e)181 f)351, 57%, 18/20.

15. Which set has one less than this set?





[MONEY]

16. How much money?

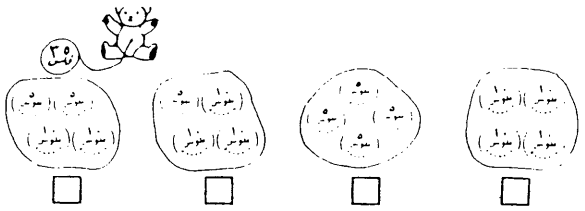


7 Fils | 11 Fils | 6 Fils | 12 Fils

Item 15. MA, G1 n=822 a)471 b)98 c)56 d)34 e)163 f)351, 57%, 16/20.

Item 16. MA, G1 n=822 a) 434 b) 736 c) 67 d) 30 e)218 f) 388, 53%, 19/20.

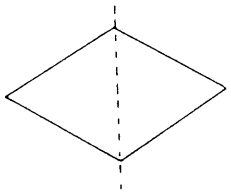
17. How much is the toy?



30 Fils ☐ 35 Fils ☐ 20 Fils ☐ 40 Fils ☐

[GEOMETRY]

18. Will this shape match if you fold it on the dotted line?



Yes ☐ No ☐

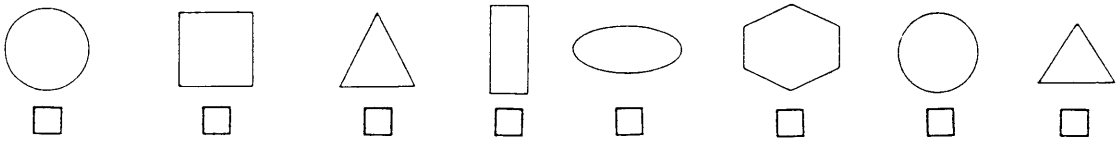
Item 17. MA, G1 n=822 a)25 b)86 c)455 d)55 e)201 f)367, 55%, 17/20.

Item 18. M, G1 n=822 a) 585 b)73 c) 0 d) 0 e) 184 f)237, 71%, 14/20.

---

19. Mark the ◯

20. Mark the △



☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

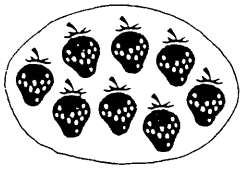
Item 19. M, G1 n=822 a)1 b)10 c)2 d)706 e)103 f)116, 86%, 10/20.

Item 20. M, G1 n=822 a)704 b)8 c)2 d)2 e)106 f)118, 86%, 9/20.

APPENDIX D
TEST BOOKLETS: (GRADE 2)
(ENGLISH VERSION)

[RECOGNITION OF WHOLE NUMBERS]

1. How many are in this set?



6 ☐ 9 ☐ 8 ☐ 7 ☐

2. What is the fourth letter in this word?

BAHRAIN

A ☐ H ☐ R ☐ N ☐

Item 1. M, G1 n=831 a)1 b)14 c)783 d)11 e)22 f)48, 94%, 1/30.

Item 2. MA, G2 n=833 a)20 b)455 c)97 d)177 e)82 f)376, 55%, 26/30.

---

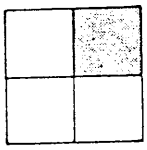
3. What is the number?

6 Hundreds 1 Ten 2 Ones

621 ☐ 216 ☐ 126 ☐ 612 ☐

[RECOGNITION OF FRACTION]

4. How much is shaded?



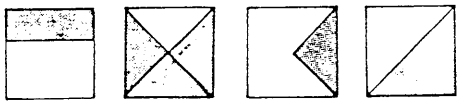
1/4 ☐ 1/2 ☐ 1/8 ☐ 3/1 ☐

Item 3. MA, G2 n=833 a)61 b)45 c)39 d)613 e)73 f)218, 74%, 19/30.

Item 4. A, G2 n=833 a)663 b)34 c)5 d)87 e)42 f)168, 80%, 12/30

---

5. Which square has 3/4 of it shaded?



☐ ☐ ☐ ☐

[ORDER AND COMPARISON OF WHOLE NUMBERS]

6. Which number is missing?

571, 572, ___, 574.

375 573 753 735

☐ ☐ ☐ ☐

Item 5 A, G2 n=833 a)4 b)15 c)698 d)12 e)102 f)133, 84%, 8/30.

Item 6. MA, G2 n=833 a)36 b)571 c)111 d)47 e)66 f)260, 69%, 12/30.

7. Which number comes next?

81, 82, 83, ___

85 80 84 86

☐ ☐ ☐ ☐

8. Which number is the largest?

435 354 534 543

☐ ☐ ☐ ☐

Item 7. A, G2 n=833 a)10 b)25 c)717 d)37 e)42 f)114, 86%, 7/30.

Item 8. MA, G2 n=833 a)111 b)93 c)123 d)433 e)71 f)398, 52%, 25/30.

9. What goes in ☐ ?

83 ☐ 38

= < >

☐ ☐ ☐

[BASIC ADDITION/SUBTRACTION FACTS]

Direction: Put (✓) under the correct answer for the following mathematical computations (10 - 20).

10.

$$\begin{array}{r} 5 \\ +\ 7 \\ \hline \\ \hline \end{array}$$

6 21 12 13

☐ ☐ ☐ ☐

Item 9. MA, G2 n=833 a)198 b)474 c)49 d)0 e)110 f)357, 57%, 23/30.

Item 10. A, G2 n=833 a)9 b)86 c)656 d)31 e)49 f)175, 79%, 13/30.

11.

8 + 0 = ---

80 7 8 0

☐ ☐ ☐ ☐

12.

$$\begin{array}{r} 18 \\ -\ 9 \\ \hline \\ \hline \end{array}$$

9 8 7 9

☐ ☐ ☐ ☐

Item 11. A, G2 n=833 a)14 b)126 c)471 d)44 e)53 f)129, 84%, 9/30.

Item 12. A, G2 n=833 a)657 b)64 c)31 d)20 e)59 f)174, 79%, 14/30.

13.

10 - 10 = ---

100 ☐ 101 ☐ 0 ☐ 10 ☐

[ADDITION/SUBTRACTION ALGORITHMS]

14.

6 + 3 + 2 = ---

11 ☐ 632 ☐ 92 ☐ 65 ☐

Item 13. A, G2 n=833 a)14 b)15 c)728 d)41 e)33 f)103, 88%, 4/30.

Item 14. A, G2 n=833 a)726 b)50 c)22 d)13 e)20 f)105, 87%, 3/30.

15.

$$\begin{array}{r} 75 \\ +\ 32 \\ \hline ---- \end{array}$$

89 ☐ 43 ☐ 107 ☐ 47 ☐

16.

$$\begin{array}{r} 514 \\ -\ 213 \\ \hline ----- \end{array}$$

727 ☐ 327 ☐ 301 ☐ 527 ☐

Item 15. A, G2 n=833 a)28 b)596 c)627 d)40 e)77 f)204, 75%, 18/30.

Item 16. A, G2 n=833 a)72 b)630 c)44 d)19 e)66 f)201, 76%, 16/30.

17.

```
  307
+ 251
-----
```

555 558 556 557

☐ ☐ ☐ ☐

18.

```
  87
- 49
-----
```

38 48 46 126

☐ ☐ ☐ ☐

Item 17. A, G2 n=833 a)39 b)655 c)50 d)28 e)59 f)176, 79%, 15/30.

Item 18. MA, G2 n=833 a)500 b)126 c)57 d)58 e)90 f)331, 60%, 22/30.

[BASIC MULTIPLICATION FACTS]

19.

2 x 4 = ---

6 4 8 2

☐ ☐ ☐ ☐

20.

5 x 3 = ---

15 8 20 10

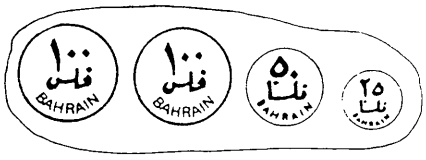
☐ ☐ ☐ ☐

Item 19. A, G2 n=833 a)36 b)23 c)719 d)24 e)29 f)112, 87%, 5/30.

Item 20. A, G2 n=833 a)668 b)44 c)44 d)25 e)50 f)163, 80%, 11/30.

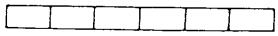
[MONEY AND MEASUREMENT]

21. How much money is shown?



275 ☐ 250 ☐ 270 ☐ 225 ☐

22. How long? Use your centimeter ruler.



7 cm ☐ 5 cm ☐ 1 cm ☐ 6 cm ☐

Item 21. MA, G2 n=833 a)383 b)127 c)55 d)188 e)78 f)448, 46%, 29/30.

Item 22. MA, G2 n=833 a)47 b)57 c)5 d)499 e)223 f)332, 60%, 21/30.

---

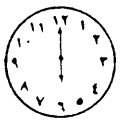
23. What time is shown?



Quarter past seven ☐ Seven O'clock ☐

Eight past Ten Minutes ☐ Twelve to Twenty ☐

24. What time is shown?



Five Past O'clock ☐ Six O'clock ☐

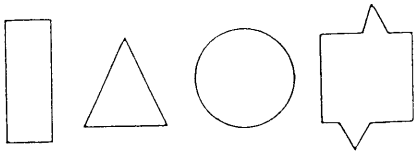
Seven to Quarter ☐ Ten Past Half ☐

Item 23. MA, G2 n=833 a)384 b)96 c)48 d)69 e)234 f)447, 46%, 28/30.

Item 24. A, G2 n=833 a)45 b)613 c)55 d)34 e)84 f)218, 74%, 17/30.

[GEOMETRY]

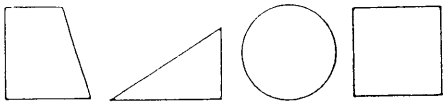
25. Which is a rectangle?



☐ ☐ ☐ ☐

Item 25. A, G2 n=833 a)15 b)9 c)71 d)688 e)48 f)143, 83%, 10/30.

26. Which is a square?



☐ ☐ ☐ ☐

Item 26. A, G2 n=833 a)762 b)7 c)9 d)13 e)40 f)69, 92%, 2/30.

27. Which two are the same size and shape?



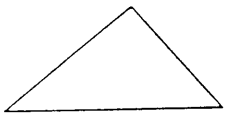
1 2 3 4

1 and 2 ☐ 2 and 3 ☐

1 and 3 ☐ 3 and 4 ☐

Item 27. MA, G2 n=833 a)90 b)18 c)343 d)22 e)358 f)488, 41%, 30/30.

28. How many sides do you see?



4 ☐ 2 ☐ 3 ☐ 1 ☐

Item 28. A, G2 n=833 a)28 b)13 c)716 d)23 e)51 f)115, 86%, 6/30.

[PROBLEM SOLVING]

29. Read the following:

In grade one 37 pupils
In grade two 36 pupils

In both grades __ pupils

63 ☐ 73 ☐ 66 ☐ 72 ☐

Item 29. MA, G2 n=833 a)110 b)467 c)76 d)53 e)125 f)364, 56%, 24/30.

30. Read the following:

Fatma has 9

Essa has 18

How many more balloons does Essa have?

9 ☐ 8 ☐ 27 ☐ 10 ☐

Item 30. MA, G2 n=833 a)401 b)61 c)228 d)47 e)94 f)430, 48%, 27/30.

APPENDIX D

TESTBOOKLET (GRADE 3)

(ENGLISH VERSION)

[RECOGNITION OF WHOLE NUMBERS]

1. What is the number?

FIFTY SIX THOUSANDS EIGHT HUNDRED SEVENTY NINE

65,800,79 ☐ 506,879 ☐

506,800,79 ☐ 56,879 ☐

2. How many thousands in this number?

71,345

13 ☐ 71 ☐ 70 ☐ 7 ☐

Item 1. A, G3 n=829 a)121 b)22 c)22 d)627 e)37 f)202, 76%, 13/30.

Item 2. A, G3 n=829 a)17 b)644 c)40 d)67 e)61 f)185, 78%, 10/30.

---

3. Which number comes before this number 961?

962 ☐ 950 ☐ 960 ☐ 861 ☐

4. Which number is 100 greater than number 4532?

5532 ☐ 4600 ☐ 4542 ☐ 4632 ☐

Item 3. MA, G3 n=829 a)114 b)43 c)509 d)98 e)65 f)320, 61%, 21/30.

Item 4. MA, G3 n=829 a)192 b)77 c)82 d)417 e)61 f)412, 50%, 26/30.

---

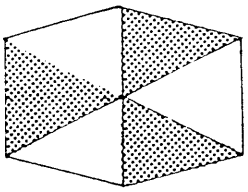
5. Round 663 to the nearest hundred.

700 ☐ 600 ☐ 500 ☐ 3001 ☐

Item 5. MA, G3 n=829 a)368 b)178 c)47 d)33 e)203 f)461, 44%, 27/30.

[RECOGNITION OF FRACTIONS]

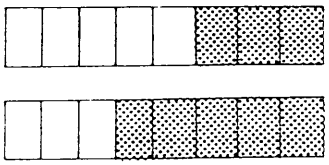
6. Which fraction tells how much is shaded?



1/6 ☐ 2/6 ☐ 4/6 ☐ 3/6 ☐

Item 6. A, G3 n=829 a)14 b)8 c)12 d)780 e)15 f)49, 94%, 1/30

7. Which fraction is greater?



3/8 ☐ 5/8 ☐

Item 7. A, G3 n=829 a)112 b)650 c)0 d)0 e)67 f)179, 78%, 9/30.

8.

1/2 of 20 = ----

10 ☐ 5 ☐ 40 ☐ 2 ☐

Item 8. A, G3 n=829 a)621 b)28 c)34 d)51 e)95 f)208, 75%, 11/30.

[BASIC ADDITION/SUBTRACTION FACTS]

Direction: Put (✓) under the correct answer for the following mathematical computations (9 - 12).

9.

```
   9
 + 9
 ---
 ----
```

0	18	17	19
☐	☐	☐	☐

10.

```
   13
 -  5
 ---
 ----
```

8	5	7	9
☐	☐	☐	☐

Item 9. A, G3 n=833 a)17 b)743 c)15 d)36 e)18 f)88, 90%, 2/30.

Item 10. A, G3 n=829 a)704 b)28 c)37 d)31 e)29 f)125, 85%, 4/30.

11.

8 + 0 = ----

80	0	8	1
☐	☐	☐	☐

Item 11. A, G3 n=829 a)21 b)95 c)678 d)1 e)34 f)151, 82%, 8/30.

12.

16 - 7 = ---

9	8	7	9
☐	☐	☐	☐

Item 12. A, G3 n=829 a)36 b)26 c)687 d)49 e)31 f)142, 83%, 6/30.

[BASIC MULTIPLICATION/DIVISIOIN FACTS]

13.

8 x 5 = ---

40 ☐ 35 ☐ 13 ☐ 3 ☐

Item 13. A, G3 n=829 a)672 b)27 c)56 d)43 e)157 f)81, 81%, 5/30.

14.

35 ÷ 5 = ---

5 ☐ 6 ☐ 7 ☐ 8 ☐

Item 14. A, G3 n=829 a)109 b)65 c)541 d)68 e)46 f)288, 65%, 17/30.

15.

9
x 6
---

54 ☐ 45 ☐ 15 ☐ 49 ☐

Item 15. A, G3 n=829 a)518 b)113 c)39 d)101 e)58 f)311, 62%, 18/30.

16.

0 ÷ 6 = ----

1 ☐ 6 ☐ 60 ☐ 0 ☐

Item 16. A, G3 n=829 a)15 b)180 c)16 d)509 e)109 f)320, 61%, 19/30.

[ADDITION/SUBTRACTION ALGORITHM]
Direction: Put (✓) under the correct answer for the following mathematical computations (17 - 18).

17.

```
   1274
+  1135
-------
```

2409 ☐ 2379 ☐ 2149 ☐ 2309 ☐

18.

```
    534
-   239
------
```

305 ☐ 395 ☐ 265 ☐ 295 ☐

Item 17. MA, G3 n=829 a)537 b)83 c)34 d)150 e)25 f)292, 65%, 16/30.

Item 18. MA, G3 n=829 a)220 b)118 c)27 d)414 e)50 f)415, 50%, 22/30.

[MULTIPLICATION/DIVISION ALGORITHM]
Direction: Put ( ) under the correct answer for the following mathematical computations (19 - 21).

19.

```
   100
+   12
-------
```

120 ☐ 1200 ☐ 12200 ☐ 1002 ☐

20.

$6\overline{)70}$

10 ☐ 10r4 ☐ 11r4 ☐ 11 ☐

Item 19. MA, G3 n=829 a)91 b)578 c)33 d)64 e)63 f)251, 70%, 15/30.

Item 20. MA, G3 n=829 a)63 b)146 c)379 d)94 e)150 f)453, 45%, 25/30.

21.

310 x 3 = ---

900 ☐ 0 ☐ 9000 ☐ 1000 ☐

[MONEY AND MEASUREMENT]

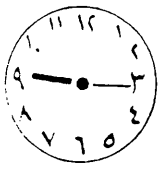
22. Mark the value that is the same as of 5 dinars?

500 Fils ☐ 5000 Fils ☐ 50000 Fils ☐ 2500 Fils ☐

Item 21. A, G3 n=829 a)322 b)82 c)108 d)77 e)240 f)507, 39%, 29/30.

Item 22. A, G3 n=829 a)197 b)431 c)109 d)34 e)58 f)398, 52%, 23/30.

23. What time is shown?



Quarter to Nine ☐ Quarter past Nine ☐

Quarter past Three ☐ Quarter to Three ☐

22. Mark the value that is the same as of 15000 grams?

150 Kgs ☐ 15 Kgs ☐ 1500 Kgs ☐ 5 Kgs ☐

Item 23. MA, G3 n=829 a)163 b)101 c)435 d)74 e)56 f)394, 52%, 24/30.

Item 24. MA, G3 n=829 a)33 b)287 c)244 d)32 e)233 f)542, 35%, 30/30.

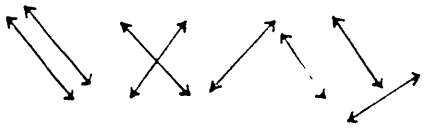
[GEOMETRY]

25. Which figure is an angle?



☐ ☐ ☐ ☐

26. Which pair of lines is parallel?



☐ ☐ ☐ ☐

Item 25. A, G3 n=829 a)2 b)14 c)14 d)745 e)54 f)84, 90%, 3/30.

Item 26. A, G3 n=829 a)9 b)13 c)66 d)667 e)74 f)162, 80%, 7/30.

[PROBLEM SOLVING]

27. There are 7 days in one week. How many days in 21 weeks?

28 3 147 174

☐ ☐ ☐ ☐

28. Ahmed has 25 chocletes. He can put 5 chocletes in one box. How many boxes can he fill?

30 5 20 125

☐ ☐ ☐ ☐

Item 27. MA, G3 n=829 a)371 b)103 c)101 d)173 e)81 f)458, 45%, 28/30.

Item 28. MA, G3 n=829 a)371 b)103 c)101 d)173 e)81 f)458, 45%, 28/30.

29.

	Dinars	Fils
Hassan has	4	300
Fatma has	2	700
Budoor has	5	100
All have	--	----

12 Dinars and 100 Fils ☐ 12 Dinars ☐

9 Dinars and 800 Fils ☐ 9 dinars and 400 Fils ☐

Item 29. A, G3 n=829 a)610 b)63 c)66 d)38 e)52 f)219, 74%, 12/30.

30.

	Dinars	Fils
Amal has	28	300
She bought a candy of	14	200
Remainder	--	----

14 Dinars and 100 Fils ☐ 12 Dinars and 300 Fils ☐

14 Dinars and 500 Fils ☐ 14 dinars and 200 Fils ☐

Item 30. MA, G3 n=829 a)479 b)69 c)160 d)64 e)57 f)350, 58%, 20/30.

APPENDIX D
TESTBOOKLET (GRADE 4)
(ENGLISH VERSION)

[RECOGNITION OF WHOLE NUMBERS]

1. What is the number?

4 MILLION TWO HUNDRED TWENTY FIVE THOUSANDS NINE HUNDRED SEVENTY FOUR

40,522,974 ☐ 422,974 ☐

40,225,974 ☐ 4,225,974 ☐

2. What is the place-value of the 4 in the this number?

1,483,764

4000 ☐ 40000 ☐

400000 ☐ 4000000 ☐

Item 1. A, G2 n=834 a)47 b)32 c)75 d)637 e)43 f)197, 76%, 6/20.

Item 2. A, G4 n=834 a)143 b)84 c)383 d)183 e)41 f)451, 46%, 18/20.

---

3. Mark <, >, or =

15, 286 ☐ 15,369

= ☐ < ☐ > ☐

[RECOGNITION AND COMPARISON OF FRACTIONS AND DECIMALS]

4. What is the decimal for this fraction?

4/10

.4 ☐ 4.0 ☐ .04 ☐ .410 ☐

Item 3. A, G4 n=834 a)538 b)216 c)31 d)0 e)49 f)296, 65%, 10/20.

Item 4. MA, G4 n=834 a)551 b)112 c)24 d)134 e)13 f)283, 66%, 8/20.

---

5. Mark the next equivalent fraction:

2/4, 4/8, 6/12, ...

8/16 ☐ 9/20 ☐ 7/15 ☐ 10/21 ☐

6. Which fraction is equal to zero:

6/6 ☐ 1/6 ☐ 0/6 ☐ 9/6 ☐

Item 5. A, G4 n=834 a)594 b)61 c)70 d)64 e)45 f)240, 71%, 5/20.

Item 6. A, G4 n=834 a)88 b)25 c)691 d)13 e)17 f)143, 83%, 3/20.

[BASIC ADDITION/SUBTRACTION FACTS]

7. Which equation belongs to this family of facts?

9 + 8 = 17
8 + 9 = 17
17 - 8 = 9
? ? ? = ?

17 - 9 = 8 ☐ 8 - 9 = 17 ☐

17 + 8 = 9 ☐ 9 - 8 = 17 ☐

[BASIC MULTIPLICATION/DIVISION FACTS]

8. Which equation belongs to this family of facts?

6 x 5 = 30
5 x 6 = 30
30 ÷ 5 = 6
? ? ? = ?

30 x 5 = 30 ☐ 30 ÷ 6 = 5 ☐

30 x 6 = 5 ☐ 5 ÷ 6 = 30 ☐

Item 7. MA, G4 n=834 a)504 b)130 c)93 d)67 e)40 f)330, 60%, 11/20.

Item 8. MA, G4 n=834 a)100 b)472 c)95 d)116 e)51 f)362, 57%, 12/20.

[ADDITION/SUBTRACTION ALGORITHM]

9. Which problem can be used to check the answer to the work in the box?

```
     8365
   - 5375
   ------
   ------
```

```
  8365        5375
+ 5375      + 2990
------      ------
```

☐ ☐

```
  8365        5375
+ 2990      - 2990
------      ------
```

☐ ☐

[MULTIPLICATION/DIVISION ALGORITHM]

Direction: Put (✓) under the correct answer for the following mathematical computations (10 - 11).

10.

```
    492
+   200
------
------
```

98400 9840 98422 818400

☐ ☐ ☐ ☐

Item 9. MA, G4 n=834 a)422 b)340 c)84 d)144 e)37 f)494, 41%, 19/20.

Item 10. MA, G4 n=834 a)413 b)89 c)90 d)194 e)48 f)421, 50%, 16/30.

11.

$$4\overline{)484}$$

121 112 122 141

☐ ☐ ☐ ☐

[FRACTION COMPUTATION]

Direction: Put ( ) under the correct answer for the following mathematical computations (12 - 13).

12.

$$4/5 + 3/5 = ---$$

7/10 7/5 1/5 2

☐ ☐ ☐ ☐

Item 11. MA, G4 n=834 a)527 b)71 c)72 d)70 e)16 f)307, 63%, 9/30.

Item 12. A, G4 n=834 a)130 b)647 c)29 d)12 e)16 f)187, 78%, 4/30.

13. [MEASUREMENT]

2 2/3 - 1 1/3 = ---

3 2/3 ☐ 1 1/3 ☐ 3 3/6 ☐ 1 3/6 ☐

14. How many days are in 5 weeks and 4 days?

39 Days ☐ 38 Days ☐

29 Days ☐ 28 Days ☐

Item 13. A, G4 n=834 a)74 b)686 c)36 d)14 e)24 f)148, 82%, 2/30.

Item 14. A, G4 n=834 a)568 b)84 c)108 d)48 e)26 f)266, 68%, 7/30.

15. What is the length to the nearest centimeter (cm). Use your ruler.



8 cm ☐ 8.5 cm ☐ 7.5 cm ☐ 9 cm ☐

16. Read the following

1 ton = 1000 Kgs
1 Kg = 1000 grs

1/2 Ton and 3 Kgs = ---

305000 Grams ☐ 530000 Grams ☐

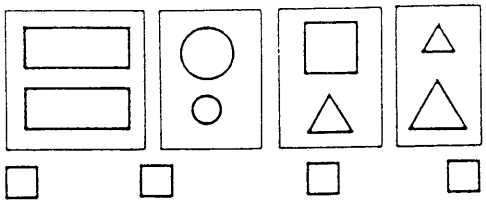
503000 Grams ☐ 350000 Grams ☐

Item 15. MA, G4 n=834 a)106 b)467 c)27 d)208 e)26 f)367, 56%, 14/30.

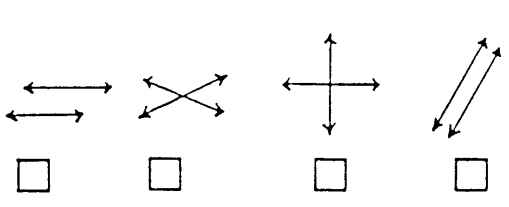
Item 16. MA, G4 n=834 a)149 b)176 c)250 d)103 e)156 f)584, 30%, 20/20.

[Geometry]

17. Which figures are congruent?



18. Which pair of lines is prependicular?



Item 17. MA, G4 n=834 a)9 b)9 c)2 d)778 e)36 f)56, 93%, 1/20.

Item 18. MA, G4 n=834 a)189 b)473 c)45 d)28 e)99 f)361, 57%, 13/20.

[PROBLEM SOLVING]

19.

Ahmed weights 46.50 Kgs
Fatma weights 40.75 Kgs

How much more does Ahmed weights

7.55 Kgs ☐ 5.75 Kgs ☐

5.70 Kgs ☐ 7.50 Kgs ☐

20. Budoor bought a dress for 6.750 B.D. and a coat for 8.950 B. D. How much did she spend in all?

15 Dinars ☐ 15 Dinars and 700 Fils ☐

15 Dinars and 900 Fils ☐ 15 dinars and 750 Fils ☐

Item 19. A, G4 n=834 a)116 b)433 c)100 d)87 e)108 f)411, 51%, 15/30.

Item 20. MA, G4 n=834 a)400 b)174 c)174 d)140 e)78 f)434, 48%, 17/30.

APPENDIX E

GENERAL STANDARD DIRECTIONS FOR TEST ADMINISTRATION
GRADES 1-4 (ARABIC VERSION)

APPENDIX E

GENERAL STANDARD DIRECTIONS FOR TEST ADMINISTRATION GRADES 1-4 (ARABIC VERSION)

ارشـــادات عامـــــــــة :

الوقت المحـــدد لهذا الاختبار ساعـــة واحـــــدة

ويرجى من الزميل / الزميلة التقيـــد بالارشـــادات التالية عند تطبيق الاختبار :

١ ــ يـــوزع كتيـــب الاختبار على كل تلميـــذ أو تلميـــذة .

٢ ــ التأكد من أن كل تلميذ / تلميـــذة معه قلم رصاص وممحـــاة .

٣ ــ مساعدة التلميذ / التلميذة على ملء البيانات المدونة على الصفحة الأولى من كتيـــب الاختبار (واذا تعذر على تلميذ / تلميذة ملء البيانات بنفسه فيمكن أن يملأها المدرس / المدرسة نيابة عنه) ، مع الاهتمام بدقـــة البيانات .

٤ ــ ينبه التلاميذ / التلميذات الى وضع علامـــة (✓) في المربع الدال على مايعتقـــد أنـــه الاجابـــة الصحيحـــة .

٥ ــ اذا أراد التلميذ أن يعدل عن اجابتـــه الى اجابة أخرى فعليه أن يمحو تمامـــا العلامـــة السابقـــة .

٦ ــ يحسب الوقت المحدد للاختبار من بدء الاجابة ، وتجمع الأوراق بعد ساعة واحدة .

٧ ــ يمكن مساعدة التلاميذ في قراءة الأسئلة وتوضيح المطلوب من السؤال دون أي ارشاد الى الاجابة الصحيحة ، وتتم هذه المساعدة بالنسبة لكل سؤال على حدة وليست بالنسبة لجميع الأسئلـــة دفعة واحدة .

٨ ــ اذا سأل تلميذ / تلميذة عما اذا كانت اجابته صحيحة أو غير صحيحة يرجى التهرب من تحديد صحة الاجابة أو عدم صحتها بكلمات مثل " جيد ــ لا أدري ــ استمـــر في الاجابـــة ... " .

٩ ــ اذا انتهى تلميذ / تلميذة من الاجابة قبل نهاية الزمن المحدد يرجى ابقـــاء الكتيب معه الى نهاية الوقت ، ويمكن تكليفه بشيء آخر ، حتى لايخرج زملاؤه متأثرين به قبل أن يتموا اجاباتهم .

١٠ ــ يرجى أن تكون المسافة بين كل تلميذين / تلميذتين بحيث لايتأثر في اجابتـــه باجابة جارة / جارتهـــا .

١١ ــ ينبه التلاميذ / التلميذات الى الاجابة عن الأسئلـــة متتالية حسب ترتيبهـــا ، فلا ينتقـــل الى الاجابة عن أسئلـــة الصفحة الثانية مثلا قبل أن ينتهي من الاجابة عن أسئلـــة الصفحة الأولى .

APPENDIX E

GENERAL STANDARD DIRECTIONS FOR TEST ADMINISTRATION
GRADES 1-4 (ENGLISH VERSION)

APPENDIX E

GENERAL STANDARD DIRECTIONS FOR TEST ADMINISTRATION
GRADES 1-4 (ENGLISH VERSION)

*. Time allocation: 60 minutes.

Dear teacher, please read the following directions carefully before administering the tests:

1. Give every child one booklets according to the grade level.

2. Be sure that each child has a pencil and eraser.

3. Help the children in filling all the information needed at the first page of the booklet. If the child cannot write (especially at grade 1), then the teacher could be fill all the information.

4. Be sure that the children check their answer by marking (✓).

5. If the students want to change his answer he has to erase completely the other response.

6. Question 18: Teacher help the children without telling or announcing the correct answer.

7. If a child hesitate about his/her answer of any question the teacher should tell the correct answer, instead of that he can give responses such as: 'continue your answer", "good", or "I do not know".

8. Please make a reasonable distance between each child and his/her classmate.

9. All children have to answer the questions in order by serial numbers by serial numbers of page. for example, start with first question NOT with question number 4 in the first page.

APPENDIX F

REQUESTED LETTER TO TEACHERS/PRINCIPALS
(ARABIC VERSION)

APPENDIX F

REQUESTED LETTER TO TEACHERS/PRINCIPALS
(ARABIC VERSION)

الزميـل الفاضل / الزميلـة الفاضلـــــة :

لايخفى عليكم الدور الأساسي الذى يقوم به المدرس فى تطبيق المفهوم التعليمى ، والرسالة السامية التى يضطلع بها فى تنشئة أجيال من شباب الأمة يتوقف عليهـــــم مستقبلهـا .

ومن خلال ممارساتكم فى مجال التدريس تدركون أن التربية فى تطور مستمر ، وأن تطوير التعليم يتطلب الاهتمام بالمتعلم ومتابعة تحصيله ، وتحديد الكفايات الأساسيـة لكل صف دراسى والوقوف على مدى ماوصل اليه المتعلم من هذه الكفايات ، وإلى أى مدى يتحقق تحقيق الكفايات الأساسية فى الرياضيات ، وتعليمها ، وتقويمها ، وصولا الـى تحقيق الأهداف التى خطط المنهج من أجلها .

والهدف من هذا الاختبار هو تحديد الكفايات فى الرياضيات من الصـــف الأول الى الصف الرابع الابتدائى ، ومدى تحقيقها عند المتعلم .

والقائم بهذا الاختبار هو الأستاذ محمد حسن المطوع اخصائى أول مناهـــــج العلوم بادارة المناهج ، كجزء من متطلبات دراسته لنيل درجة الدكتوراة . وهو اذ يقدر لكم تعاونكم يرجو الاهتمام بهذا الاختبار لما يتوقع من نتائج لهذه الدراسة تعـــود بمردود طيب على عملية التعليم بدولة البحرين .

ونعـود لنكرر لكـم الشكر على تعاونكم فى انجاح هذه الدراســـة .

واللـــــه ولـى التوفيـــق ،،،

محمد حسن المطـوع

APPENDIX F

REQUESTED LETTER TO TEACHERS/PRINCIPALS
(ENGLISH VERSION)

APPENDIX F

REQUESTED LETTER TO TEACHERS/PRINCIPALS

(ENGLISH VERSION)

To Teacher/Principal:

Dear Sir:

Through your practice and experiences in teaching mathematics, you might recognize that the children's progressiveness of mathematical skills in your classroom is inconsistence with your assessment.

This study is an indication of the student performance on the mandated mathematical skills and instruction in your elementary school. This study used an alignment technology to investigate the instructional gaps that are reflected on textbook and curriculum objectives based on student accomplishment.

The suggested test booklets are served for this study to reflect any of these gaps regrding the instructional transaction within the first four grades at elementary level.

This test was constructed and developed by the investigator for a research purpose as a partial fulfillment required to the doctoral degree of philosophy in educational psychology. And he is appreciated your assistance in administering these tests in your school.

Sincerely Yours

Mohamed Hassan Al-Mutawa
Senior Curriculum
Specialist

For Further Information
Ministry of Education
Directorate of Curricula
P. O. Box 43
Tel. #. 244019

APPENDIX G

APPRECIATION LETTER TO PRINCIPALS/TEACHERS
(ARABIC VERSION)

APPENDIX G

APPRECIATION LETTER TO PRINCIPALS/TEACHERS (ARABIC VERSION)

إلى :

الزميل الفاضل / الزميلة الفاضلة

تحية طيبة وبعد ،

لا يسعني إلا أن أتقدم إليكم بوافر الشكر على المعاونة الصادقة والجهد اللذين بذلتموهما أثناء عقد اختبار تحديد الكفايات في الرياضيات للتلاميذ الصفوف الأربعة الأولى من المرحلة الابتدائية ، ومدى تحقيقها عند المتعلم .

ولقد كان لمعاونتكم الفعالة أثر كبير في سير الدراسة التي أقوم بها .

ويسرني أن أقدم لكم مجموعة من هذه الاختبارات راجيا أن تعينكم على أداء رسالتكم التعليمية ، ولتكون نموذجا مقترحا لإعداد الاختبارات التي تعدونها للوقوف على تحصيل تلاميذكم مستقبلا .

وتقبلوا جزيل الشكر والتقدير ،

محمد حسن المطوع
الأخصائي الأول للعلوم

إلى :

الزميل الفاضل / الزميلة الفاضلة

تحية طيبة وبعد ،

لا يسعني إلا أن أتقدم إليكم بوافر الشكر على المعاونة الصادقة والجهد اللذين بذلتموهما أثناء عقد اختبار تحديد الكفايات في الرياضيات للتلاميذ الصفوف الأربعة الأولى من المرحلة الابتدائية ومدى تحقيقها عند المتعلم .

ولقد كان لمعاونتكم الفعالة أثر كبير في سير الدراسة التي أقوم بها .

ويسرني أن أقدم لكم مجموعة من هذه الاختبارات راجيا أن يفيد منها مدرسو الرياضيات بمدرستكم .

وتقبلوا جزيل الشكر والتقدير ،

محمد حسن المطوع
الأخصائي الأول للعلوم

APPENDIX G

APPRECIATION LETTER TO PRINCIPALS/TEACHERS
(ENGLISH VERSION)

APPENDIX G

APPRECIATION LETTER TO PRINCIPALS/TEACHERS
(ENGLISH VERSION)

To Principal:

Dear Sir:

Thank you for your corporation with me in administering the tests in the first four grades in your school. Your corporation is very essential to my work progress.

Attached are examples of tests booklets which I hope might be beneficial to your mathematics teachers in your school.

Your Sincerely

Mohamed Hassan al-Mutawa
Senior Curriculum Specialist

To Teacher:

Dear Sir:

Thank you for your corporation with me in administering the tests in the first four grades in your school. Your corporation is very essential to my work progress

Attached are samples of tests booklets which I hope would work as a model for test's development in mathematics area.

Your Sincerely

Mohamed Hassan al-Mutawa
Senior Curriculum Specialist

APPENDIX H

TABLE 1

POINT-BISERIAL CORRELARION COEFFIECIENT BY ITEM AND GRADE LEVEL (1-4)

APPENDIX H

TABLE 1

POINT-BISERIAL CORRELARION COEFFIECIENT BY ITEM AND GRADE LEVEL (1-4)

	Grades			
	1st grade	2nd grade	3rd grade	4th grade
Items number				
1	0.43	0.35	0.35	0.41
2	0.43	0.33	0.43	0.48
3	0.37	0.42	0.53	0.45
4	0.42	0.34	0.37	0.48
5	0.39	0.26	0.35	0.54
6	0.46	0.49	0.31	0.28
7	0.42	0.47	0.13	0.49
8	0.01	0.40	0.41	0.50
9	0.45	0.21	0.42	0.46
10	0.48	0.46	0.44	0.47
11	0.53	0.48	0.48	0.56
12	0.52	0.48	0.40	0.49
13	0.46	0.49	0.50	0.46
14	0.34	0.43	0.55	0.46
15	0.42	0.49	0.49	0.48
16	0.50	0.51	0.42	0.26
17	0.55	0.52	0.52	0.30
18	0.48	0.56	0.38	0.33
19	0.50	0.46	0.41	0.40
20	0.53	0.53	0.34	0.39
21		0.48	0.47	
22		0.12	0.48	
23		0.44	0.41	
24		0.50	0.43	
25		0.36	0.20	
26		0.34	0.24	
27		0.32	0.38	
28		0.35	0.45	
29		0.38	0.47	
30		0.35	0.47	

APPENDIX I

TABLES 2-5

PEARSON-PRODUCT-MOMENT OF TOPIC-TOPIC AND TOPIC-TOTAL CORRELATION COEFFICIENTS AT GRADE 1-4

APPENDIX I

TABLE 2

PEARSON-PRODUCT-MOMENT OF TOPIC-TOPIC AND TOPIC-TOTAL CORRELATION COEFFICIENTS AT GRADE 1

	TOPICS					
TOPICS	T1[a]	T2	T3	T4	T5	TOTAL
T1	1.*	38[b]	32	39	32	76
T2	38	1.	38	24	30	64
T3	32	38	1.	21	22	66
T4	39	24	21	1.	35	63
T5	32	30	22	35	1.	63
TOTAL	76	64	66	63	63	1.

Note 1. a: All decimal points ommitted.

*P > .01

Note 2. b: T1 (PLACE AND SIZE RELATIONSHIP), T2 (NUMBER RECOGNITION), T3 (NUMBER COMPARISON), T4 (MEASUREMENT) AND T5 (GEOMETRY).

APPENDIX I

TABLE 3

EARSON-MOMENT-PRODUCT OF TOPIC-TOPIC AND TOPIC-TOTAL CORRELATION COEFFICIENTS AT GRADE 2

	TOPICS									
TOPICS	T2[a]	T3	T4	T5	T6	T7	T8	T11	T13	TOTAL
T2	1.	32*	31[b]	21	33	31	27	19	19	56
T3	32	1.	34	22	35	36	26	17	19	62
T4	31	34	1.	22	31	41	31	14	30	65
T5	21	22	22	1.	31	32	23	16	24	54
T6	33	35	31	31	1.	55	41	24	24	71
T7	31	36	41	32	55	1.	46	27	29	78
T8	27	26	31	23	41	46	1.	24	19	59
T11	20	17	14	16	24	27	24	1.	10	40
T13	19	19	30	24	24	29	19	10	1.	48
TOTAL	56	62	65	54	71	78	59	40	48	1.

* $p > .01$.

Note 1. a: All decimal points ommitted.

Note 2. b: Topics (T); T2 (NUMBER RECOGNITION), T3 (NUMBER COMPARISON), T4 (MEASUREMENT), T5 (GEOMETRY), T6 (BASIC ADDITION/SUBTRACTION FACTS), T7 ADDITION/SUBTRACTION ALGORITHMS), T8 BASIC MULTIPLICATION AND DIVISION FACTS), T11 (FRACTION RECOGNITION) AND T13 (PROBLEM SOLVING).

APPENDIX I

TABLE 4

PEARSON-PRODUCT-MOMENT OF TOPIC-TOPIC AND TOPIC-TOTAL CORRELATION COEFFICIENTS AT GRADE 3

	TOPICS											
TOPICS	T2[a]	T3	T4	T5	T6	T7	T8	T9	T10	T11	T13	TOTAL
T2	1.	27*	18	15[b]	32	30	28	25	15	15	28	49
T3	27	1.	47	07	31	24	32	36	37	20	40	66
T4	18	47	1.	-02	26	21	28	40	44	20	38	64
T5	15	07	-02	1.	17	12	12	08	07	06	19	27
T6	32	31	26	17	1.	38	41	31	25	34	36	65
T7	30	24	21	12	38	1.	32	24	21	20	32	55
T8	28	32	28	12	41	32	1.	35	28	18	39	61
T9	25	36	40	08	31	24	35	1.	37	20	36	62
T10	15	37	44	07	25	21	28	37	1.	13	32	60
T11	15	20	20	06	34	20	18	20	13	1.	21	43
T13	28	40	38	19	36	32	39	36	32	21	1.	71
TOTAL	49	66	64	27	65	55	61	62	60	43	71	1.

* $p > .01$

Note 1. a: Topics (T); T2 (NUMBER RECOGINTION), T3 (NUMBER COPMARISON), T4 (MEASUREMENT), T5 (GEOMETRY), T6 (BASIC ADDITION/SUBTRACTION FACTS), T7 (ADDITION/SUBTRACTION ALOGORITMS), T8 (BASIC MULTIPLICATION FACTS), T9 (BASIC DIVISION FACTS), T10 (MULTIPLICATION/DIVISION ALOGORITHMS), T11 (FRACTION RECOGNITION), AND T13 (PROBLEM SOLVING).

Note 2. b : All decimal points ommitted.

APPENDIX I

TABLE 5

PEARSON-PRODUCT-MOMENT OF TOPIC-TOPIC AND TOPIC-TOTAL CORRELATION COEFFICIENTS AT GRADE 4

	TOPICS[a]												
TOPICS	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	TOTAL
T2	1.	22*	32[b]	16	23	26	25	25	34	31	33	18	66
T3	22	1.	21	12	17	20	18	18	23	24	20	12	44
T4	32	21	1.	23	26	16	19	19	28	30	27	27	63
T5	16	12	23	1.	14	05	13	13	14	10	22	20	41
T6	23	17	26	14	1.	19	38	38	20	28	18	15	49
T7	26	20	16	05	19	1.	22	22	26	30	16	14	46
T8	25	18	19	13	38	22	1.	1.	23	30	20	16	50
T9	25	18	19	13	38	22	1.	1.	23	30	20	16	50
T10	34	23	28	14	20	26	23	23	1.	40	32	18	63
T11	31	24	30	10	28	30	30	30	40	1.	38	12	66
T12	33	20	27	22	18	16	20	20	32	38	1.	22	59
T13	18	12	27	20	15	14	16	16	18	12	22	1.	49
TOTAL	61	44	63	41	49	46	50	50	63	66	59	49	1.

* $p > .01$.

Note 1. b: All decimal points ommitted.

Note 2. a: Topics (T); T2 (NUMBER RECOGNITION), T3 (NUMBER COMPARISON), T4 (MEASUREMENT), T5 (GEOMETRY), T6 (BASIC ADDITION/SUBTRACTION FACTS), T7 (ADDITION AND SUBTRACTION ALGORITHMS), T8 (BASIC MULTIPLICATION FACTS), T9 (BASIC DIVISION FACTS), T10 (MULTIPLICATION AND DIVISION ALGORITHMS), T11 (FRACTION RECOGNITION), T12 (FRACTION COMPUTATION) AND T13 (PROBLEM SOLVING).

APPENDIX J

TABLES 6-9

PEARSON-PRODUCT-MOMENT OF ITEM-ITEM CORRELATION COEFFICIENTS AT GRADE 1-4

APPENDIX J

TABLE 6
PEARSON-PRODUCT-MOMENT OF ITEM-ITEM CORRELATION COEFFICIENTS AT GRADE 1

	ITEMS									
ITEMS	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10
I1	1.*	44[a]	30	30	17	05	16	02	18	17
I2	44	1.	32	46	20	05	11	03	17	17
I3	30	32	1.	31	10	02	17	-01	11	10
I4	30	46	31	1.	15	12	10	05	22	15
I5	17	20	10	15	1.	12	13	-07	14	15
I6	05	05	02	12	12	1.	12	-02	11	11
I7	16	11	17	10	13	12	1.	-14	15	15
I8	02	03	-01	05	-07	-02	-14	1.	-06	-01
I9	18	17	11	22	14	11	15	-06	1.	29
I10	17	17	10	15	15	11	15	-01	29	1.
I11	22	16	14	13	18	17	27	-29	24	53
I12	27	18	16	18	17	15	22	-06	32	30
I13	08	07	06	12	20	15	25	-16	29	25
I14	11	09	13	05	16	01	12	-06	10	09
I15	10	07	08	09	10	05	12	01	17	15
I16	15	14	17	09	15	23	18	01	13	13
I17	13	16	19	16	14	30	15	-00	14	10
I18	13	11	13	13	16	27	09	-08	16	17
I19	13	09	12	13	10	30	10	-08	13	21
I20	15	13	08	11	11	31	11	-10	15	20

TABLE 8 CONTINUED

	ITEMS									
ITEMS	I11	I12	I13	I14	I15	I16	I17	I18	I19	I20
I11	1.	35	27	02	10	22	16	18	21	20
I12	35	1.	24	16	17	16	14	12	14	22
I13	27	24	1.	14	15	16	15	09	17	19
I14	02	16	14	1.	31	04	04	05	04	05
I15	10	17	15	31	1.	09	13	17	10	09
I16	22	16	16	04	09	1.	39	17	14	18
I17	16	14	15	04	13	39	1.	29	28	32
I18	18	12	09	05	17	17	29	1.	30	35
I19	21	14	17	04	10	14	28	30	1.	69
I20	20	22	19	05	09	18	32	35	69	1.

Note. a: All decimals point ommitted. *p > .01

APPENDIX J

TABLE 7
PEARSON-MOMENT-PRODUCT OF ITEM-ITEM CORRELATION COEFFICIENTS AT GRADE 2

	ITEMS									
ITEMS	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10
I1	1.	12*	10[a]	08	12	12	22	10	24	24
I2	12	1.	10	12	06	16	11	07	87	09
I3	10	10	1.	20	-02	16	18	24	09	13
I4	08	12	20	1.	07	16	10	11	02	08
I5	12	06	-02	07	1.	07	07	06	04	08
I6	12	16	16	16	0	1.	29	18	04	20
I7	22	11	18	10	07	29	1.	23	09	22
I8	10	07	24	11	06	18	23	1.	18	13
I9	02	09	09	02	04	04	10	18	1.	10
I10	24	09	13	08	08	20	22	13	10	1.
I11	21	10	11	17	09	19	23	10	08	28
I12	13	17	16	18	10	18	19	13	04	23
I13	20	13	16	15	11	19	25	16	-17	31
I14	23	12	04	12	09	20	27	07	-05	20
I15	16	11	15	12	09	21	20	19	04	21
I16	13	09	11	11	13	25	18	16	06	20
I17	19	14	14	16	14	25	17	13	-03	22
I18	17	15	16	18	15	28	26	11	38	20
I19	20	12	15	13	11	20	17	13	00	19
I20	23	15	12	19	16	22	21	16	02	21

TABLE 7 CONTINUED

	ITEMS									
ITEMS	I11	I12	I13	I14	I15	I16	I17	I18	I19	I20
I1	21	13	20	23	16	13	19	17	20	23
I2	10	17	13	12	11	09	14	15	12	15
I3	11	16	16	04	15	11	14	16	15	12
I4	17	18	15	12	12	11	16	18	13	19
I5	09	10	11	09	09	13	14	15	11	16
I6	91	81	92	02	12	52	52	82	02	2
I7	23	19	25	27	20	18	17	26	17	21
I8	10	13	16	07	19	16	13	11	13	16
I9	08	04	-02	-05	04	06	-03	04	00	02
I10	28	23	31	20	21	20	22	20	19	21

Note. a: All decimals points ommitted.
* $p > .01$

TABLE 7 CONTINUED

	ITEMS									
ITEMS	I11	I12	I13	I14	I15	I16	I17	I18	I19	I20
I11	1.	29	26	31	17	25	24	26	23	31
I12	29	1.	23	27	21	25	23	29	18	27
I13	26	23	1.	38	25	25	31	23	21	23
I14	31	27	38	1.	16	24	26	23	21	26
I15	17	21	25	16	1.	26	33	32	18	27
I16	25	25	25	24	26	1.	38	31	27	24
I17	24	23	31	26	33	37	1.	26	29	32
I18	26	29	23	23	32	31	26	1.	22	27
I19	23	18	21	21	18	27	29	22	1.	41
I20	31	27	23	26	27	24	32	27	41	1.

TABLE 7 CONTINUED

	ITEMS									
ITEMS	I21	I22	I23	I24	I25	I26	I27	I28	I29	I30
I1	13*	07	08	18	15	15	02	08	06	07
I2	19	-10	08	14	09	02	10	07	05	02
I3	21	11	18	20	09	14	12	08	16	19
I4	10	-07	09	12	05	06	12	08	07	07
I5	10	-01	09	08	11	08	-03	12	08	-01
I6	25	02	14	25	12	03	13	09	15	10
I7	16	02	15	20	17	17	07	19	08	15
I8	17	06	15	13	12	09	08	08	10	09
I9	05	10	08	06	04	10	-02	01	02	01
I10	14	02	15	21	12	21	10	12	12	10
I11	17	00	17	14	16	16	12	12	14	13
I12	18	02	14	20	16	11	05	13	17	09
I13	13	01	14	17	17	11	11	14	13	10
I14	12	03	13	19	21	16	08	15	11	04
I15	18	02	19	24	17	13	14	09	15	12
I16	22	-03	17	26	15	06	10	15	11	18
I17	24	-01	16	23	10	07	11	11	13	14
I18	27	01	17	30	15	18	14	17	16	21
I19	18	04	11	22	11	14	06	17	10	08
I20	21	02	15	29	14	15	09	15	16	12
I21	1.	-03	23	24	07	09	14	12	21	14
I22	-03	1.	13	-02	09	-01	-09	-03	-02	03
I23	23	13	1.	22	11	08	14	07	22	18

Note. All decimals points ommitted
* $p > .01$

TABLE 7 CONTINUED

ITEMS	ITEMS									
	I21	I22	I23	I24	I25	I26	I27	I28	I29	I30
I24	24	-02	22	1.	11	13	13	19	15	13
I25	07	09	11	11	1.	30	09	19	10	05
I26	09	-01	08	13	30	1.	16	28	08	12
I27	14	-09	14	13	09	16	1.	17	13	15
I28	12	-03	07	19	19	28	17	1.	13	13
I29	21	-02	22	15	10	08	13	13	1.	14
I30	14	03	18	13	05	12	15	13	14	1.

Note. All decimals points ommitted
* p > .01

APPENDIX J

TABLE 8

PEARSON-MOMENT-PRODUCT OF ITEM-ITEM CORRELATION COEFFICIENTS AT GRADE 3

	ITEMS									
ITEMS	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10
I1	1.	22*	17	16	02	10	10	03	16	13
I2	22	1.	22	10	15	16	01	11	18	22
I3	17	22	1.	15	10	12	01	23	17	21
I4	16	10	15	1.	05	-02	08	06	08	09
I5	02	15	10	05	1.	09	-10	23	07	08
I6	10	16	12	-02	09	1.	07	15	22	17
I7	10	01	01	08	-10	07	1.	10	15	06
I8	03	11	23	06	23	15	10	1.	26	18
I9	16	18	17	08	07	22	15	26	1.	25
I10	13	22	21	09	08	17	06	18	25	1.
I11	20	14	25	13	14	19	06	18	18	23
I12	16	14	16	13	05	20	06	15	23	30
I13	12	19	24	16	08	14	05	13	22	27
I14	21	22	23	20	14	14	06	16	18	17
I15	18	21	21	17	13	12	04	12	21	17
I16	07	13	17	19	16	12	-01	16	07	14
I17	21	22	28	13	05	19	07	16	25	25
I18	18	16	19	07	02	13	05	09	14	21
I19	13	11	24	07	04	10	-00	16	19	11
I20	-02	05	19	11	16	04	-10	07	03	09

(Table 8 continued).

	ITEMS									
ITEMS	I11	I12	I13	I14	I15	I16	I17	I18	I19	I20
I1	20*	16	12	21	18	07	21	18	13	-19
I2	14	14	19	22	21	13	22	16	11	05
I3	25	16	24	23	21	17	28	19	24	19
I4	13	13	16	20	17	19	13	07	07	11
I5	14	05	08	14	13	16	05	02	04	16
I6	19	20	14	14	12	12	19	13	10	04
I7	06	06	05	06	04	-01	07	05	-00	-10

Note. All decimal points ommitted
* $p > .01$.

(Table 8 continued).

	ITEMS									
ITEMS	I11	I12	I13	I14	I15	I16	I17	I18	I19	I20
I8	18	15	13	16	12	16	16	09	16	07
I9	18	23	22	18	21	07	25	14	19	03
I10	23	30	27	17	17	14	25	21	11	09
I11	1.	30	27	24	20	16	21	18	14	11
I12	30	1.	21	21	21	11	23	17	08	05
I13	27	21	1.	35	32	15	26	17	12	13
I14	24	21	35	1.	30	24	23	19	24	18
I15	20	21	32	30	1.	11	22	22	17	11
I16	16	11	15	24	11	1.	16	05	12	10
I17	21	23	26	23	22	16	1.	32	22	07
I18	18	17	17	19	22	05	32	1.	10	09
I19	14	08	12	24	17	12	22	10	1.	20
I20	11	05	13	18	11	10	07	09	20	1.

TABLE 8 CONTINUED

	ITEMS									
ITEMS	I21	I22	I23	I24	I25	I26	I27	I28	I29	I30
I1	05*	06	06	08	04	15	06	07	17	13
I2	15	19	11	09	06	11	14	17	17	17
I3	13	23	28	20	10	07	21	26	19	19
I4	18	15	17	13	04	06	10	14	14	13
I5	31	18	12	38	-01	-04	18	16	05	15
I6	07	12	18	03	09	10	06	09	11	08
I7	-08	02	-00	-09	-03	01	02	00	10	07
I8	25	16	18	21	01	05	16	07	13	12
I9	13	08	16	08	10	08	07	14	19	18
I10	11	12	09	12	10	11	09	12	28	17
I11	23	14	15	16	08	12	12	15	18	14
I12	07	07	18	04	05	10	09	11	19	18
I13	20	16	16	14	08	06	14	22	24	20
I14	25	24	18	22	07	07	18	24	17	21
I15	19	23	16	11	09	08	13	19	24	23
I16	28	24	15	27	00	07	18	15	15	13
I17	15	20	17	09	09	10	07	17	34	26
I18	07	12	09	02	06	08	07	07	20	16
I19	14	24	22	20	04	04	13	12	12	13

Note. a: all decimal points ommitted
* $p > .01$.

TABLE 8 CONTINUED

	ITEMS									
ITEMS	I21	I22	I23	I24	I25	I26	I27	I28	I29	I30
I20	22	17	07	19	12	07	13	20	06	08
I21	1.	23	15	40	-02	-00	19	17	12	15
I22	23	1.	21	26	01	01	22	19	18	17
I23	15	21	1.	14	02	03	10	18	13	15
I24	40	26	14	1.	-05	-08	27	17	07	09
I25	-02	01	02	-05	1.	33	03	10	13	09
I26	-10	03	-08	33	33	1.	01	15	15	15
I27	19	22	10	27	03	01	1.	13	09	12
I28	17	19	18	17	10	15	13	1.	20	24
I29	02	18	13	07	13	15	09	20	1.	35
I30	15	17	15	09	09	15	12	24	35	1.

Note. a: all decimal points ommitted
* p > .01.

APPENDIX J

TABLE 9

PEARSON-PRODUCT-MOMNET OF ITEM-ITEM CORRELATION COEFFICIENTS AT GRADE 4

	ITEMS									
ITEMS	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10
I1	1.[a]	09*	12	20	18	06	11	13	13	15
I2	09	1.	19	16	24	06	22	23	24	19
I3	12	19	1.	15	22	11	17	18	20	14
I4	20	16	15	1.	28	10	18	23	24	22
I5	18	24	22	28	1.	15	25	27	20	23
I6	06	06	11	10	15	1.	13	09	16	13
I7	11	22	17	18	25	13	1.	38	19	12
I8	13	23	18	23	27	09	38	1.	22	16
I9	13	24	20	24	20	16	19	22	1.	18
I10	15	19	14	22	23	13	12	16	18	1.
I11	28	20	22	30	30	10	20	21	24	32
I12	21	20	15	27	20	05	14	16	14	14
I13	23	14	17	26	27	12	16	17	12	12
I14	15	18	15	15	27	13	21	19	12	19
I15	20	16	15	17	17	05	21	10	12	15
I16	06	13	09	08	07	05	07	06	07	11
I17	12	11	07	16	10	07	11	16	10	09
I18	07	09	11	-02	11	-03	11	07	01	07
I19	07	12	12	04	12	-10	13	13	11	07
I20	12	12	07	05	13	05	11	13	13	13

TABLE 9 CONTINUED

	ITEMS									
ITEMS	I11	I12	I13	I14	I15	I16	I17	I18	I19	I20
I1	28	21	23	15	20	06	12	07	07	12
I2	20	20	14	18	16	13	11	09	12	12
I3	22	15	17	15	15	09	07	11	12	07
I4	30	27	26	15	17	08	16	-02	04	05
I5	30	20	27	27	17	07	10	11	12	13
I6	10	05	12	13	05	05	07	-03	-01	05
I7	20	14	16	21	21	07	11	11	13	11
I8	21	16	17	19	10	06	16	07	13	13

Note. a: All decimal points ommitted.
* $p > .01$.

TABLE 9 CONTINUED

	ITEMS									
ITEMS	I11	I12	I13	I14	I15	I16	I17	I18	I19	I20
I9	24*	14	12	12	12	07	10	01	11	13
I10	32	14	12	19	15	11	09	07	07	13
I11	1.	29	30	21	18	03	14	08	14	14
I12	29	1.	27	15	21	08	14	15	18	17
I13	30	27	1.	21	16	-00	15	11	11	10
I14	21	15	21	1.	19	09	15	09	10	09
I15	18	21	16	19	1.	04	11	18	30	22
I16	03	08	-00	09	04	1.	02	11	06	03
I17	14	14	15	15	11	02	1.	14	07	08
I18	08	15	11	09	18	11	14	1.	13	18
I19	14	18	11	10	30	06	07	13	1.	30
I20	14	17	10	09	22	03	08	18	30	1.

Note. a: All deciaml points ommitted

* $p > .01$.