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ABSTRACT

This paper reports on a content analysis of the Portable Assisted Study Sequence (PASS) mathematics curricular materials designed for migrant students in California. The study compared PASS curriculum content to the National Council of Teachers of Mathematics (NCTM) Curriculum and Evaluation Standards for School Mathematics. The PASS Program, which serves migrant students in 165 schools in California, allows migrant students to carry portable work-text units from one school to another and to transfer credits within state and to at least 20 other states. The curricular materials analyzed for this study were the 1989 PASS curricula titled General Math A and B and the 1995 curricula titled Integrated Math A and B. The 1995 materials were developed to replace and update the 1989 materials in accord with NCTM standards. The Mathematics Materials Analysis Instrument (MMAI) was developed to quantify the relationship between mathematics materials and recommendations found in the NCTM standards. Data were obtained from data collection worksheets and word sort lists containing frequency counts for curriculum in grades 5-8 and 9-12. Word lists were manually examined for key word-in-context listings, classifications of words into content categories, and co-occurrences. Curricula were also examined by comparing titles, subheadings, section headings, student directions, and teacher guidelines. Results indicate that the 1995 PASS curricular materials measurably improved upon the 1989 materials with respect to NCTM standards. In addition, the study indicates that the MMAI is an effective and reliable instrument for measuring the extent to which curricular materials meet NCTM standards. Contains 80 references; the MMAI for grades 5-8 and 9-12; and instructions for coding, calculating, and interpreting the MMAI. (LP)

A Content Analysis Study of Portable Assisted Study Sequence Mathematics Curricular Materials for Migrant Students using the National Council of Teachers of Mathematics Standards

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Abstract

Mathematics curricular materials are often written to reflect reform standards to serve the future needs of the student population. This paper discusses the findings from the researcher's doctoral dissertation that involved content analysis and comparisons of Portable Assisted Study Sequence (P.A.S.S.) mathematics curricular materials designed for the migrant student population. This study was undertaken because no research had analyzed mathematics materials written for the migrant student population with respect to National Council of Teachers of Mathematics Curriculum and Evaluation Standards for School Mathematics (1989). Furthermore, an evaluative instrument designed to measure the extent to which reform ideas in the Standards are represented in the materials did not exist. These are needed because it is becoming increasingly important to evaluate curricular materials with respect to the Standards if we intend to radically change our mathematics curriculum.

The migrant student represents one segment of the student population with deficiencies in mathematics training at the K-12 level. The P.A.S.S. Program serves migrant students in 165 schools in California as well as schools across the nation, and is legally bound to provide materials meeting reform standards. The 1995 curricular materials were compared through content analysis to the 1989 materials they replaced with respect to the Standards. This required the design and use of an evaluative instrument, Mathematics Materials Analysis Instrument (MMAI), to determine whether it is possible to measure the extent to which the materials are meeting reform standards.

Nonparametric and qualitative analysis methods, including the use of Nud*Ist qualitative data analysis software, were used in this study. The researcher found the 1995 P.A.S.S. curricular materials measurably improve upon the 1989 materials with respect to the Standards, and the evaluative instrument MMAI effectively and reliably measures the extent to which curricular materials meet the Standards. The researcher concluded that the studied 1995 P.A.S.S. curricular materials are reflecting reform standards, and that an instrument now exists to quantitatively measure the extent to which reform ideas in the Standards are represented in the materials. This instrument can be improved upon, and the researcher acknowledges this study represents a pioneering effort in the mathematics reform movement.

Introduction

Mathematics curricular materials are often written to reflect reform standards to serve the future needs of the student population. Migrant students represent one segment of the student population with deficiencies in mathematics training at the K-12 level. The Portable Assisted Study Sequence (P.A.S.S.) Program serves migrant students in 165 schools in California as well as schools across the nation. The P.A.S.S. Program designs curricular materials for this population and is legally bound to provide materials meeting the California mathematics framework. This framework reflects ideas and concepts envisioned in the National Council of Teachers of Mathematics Curriculum and Evaluation Standards for School Mathematics (1989).

This paper discusses the findings from the researcher's doctoral dissertation that involved content analysis and comparisons of Portable Assisted Study Sequence (P.A.S.S.) mathematics curricular materials designed for the migrant student population. This study was undertaken because no research had analyzed mathematics curricular materials written for the migrant student population with respect to National Council of Teachers of Mathematics Curriculum and Evaluation Standards for School Mathematics (1989). Furthermore, an evaluative instrument designed to measure the extent to which reform ideas in the Standards are represented in the curricular materials did not exist. These are needed because it is becoming increasingly important to evaluate curricular materials with respect to the Standards if we intend to radically change our mathematics curriculum.

The 1995 P.A.S.S. curricular materials were compared through content analysis to the 1989 P.A.S.S. materials they replaced with respect to the Standards. This required the design and use of an evaluative instrument, Mathematics Materials Analysis Instrument (MMAI) (Appendix A), to determine whether it is possible to measure the extent to which the curricular materials are meeting the Standards.

Background and Current Research

Mathematics Reform Standards. The reform movement in mathematics is not new; it changes from decade to decade depending on societal needs and influences. These needs and influences are economic, political, social, environmental and so forth. Our society has required mechanistic types of output and thought processes for several decades. Futurists believe productivity in the 21st century will depend upon a technologically literate, creative workforce able to work in multicultural teams, as well as independently, to solve global problems. These workers will need to consider the full ramifications of their decisions across all disciplines rather than the narrow focus of their own environment. The mathematics curriculum must provide for these expectations by helping students learn mathematics as a process of experimenting, abstracting, generalizing, and specializing rather than a litany of extolled facts and theories.

The reform standards that are currently shaping U.S. mathematics curriculum are the Curriculum and Evaluation Standards for School Mathematics (National Council of Teachers of Mathematics, 1989). The Standards, as the document is called, are designed to move mathematics curriculum forward to meet the needs of students for the future. A majority of states are now involved in the development, revision, and implementation of state frameworks in mathematics, and many mathematics frameworks agree with the recommendations of the Standards.

The Migrant Student and Immigration

The migrant student is a special concern in education. The migrant student is the child of migratory workers who are often fishermen or agricultural workers, and they move from one state or district to another for the purpose of finding temporary or seasonal employment (Cahape, 1993; California Department of Education, Handbook, 1992; U. S. Department of Education, 1985). Velazquez (1994) discusses the movement of migrant workers along three identifiable streams: Eastern, Mid-Continent, and Western. The Western stream is the largest, "extending from California and Arizona to Oregon and Washington" (p. 32).

Many immigrants are migratory workers, and many of the immigrant migratory workers are illegal. There is some disagreement on statistics relating to these workers. Schuck (1995) believes that "the vast majority of aliens [foreigners] who enter illegally are more or less seasonal migrants" (p. 90). Trotter (1992) estimates that 95% of illegal immigrants are farm workers, and 90% of these are Latino.

Schlosser (1995) maintains that 30% to 60% of the migrant workers in California are illegal immigrants. Velazquez (1994) claims undocumented workers comprise only 15% of all migrants. Doyle (1990) cites studies that support this smaller number, and claims that many of the labeled migrant students maintain stable residences.

California is presently struggling with the issue of illegal immigration due to the great influx of two to three million illegal residents (Cox News Service, 1997; Schuck, 1995; O'Halloran, 1994). Proposition 187, approved by California voters in November 1994, is an anti-illegal immigrant initiative that has caused much controversy and alarm throughout the United States. It seeks to eliminate educational, medical, and welfare funding for illegal residents, with many Mexican-Americans supporting the proposition (Schuck, 1995). Support for the proposition is fueled by the illegal immigrant's fierce allegiance to Mexican nationalism and defiance of Americanization (defined by Aldama, 1995, as assimilation, acculturation, and citizenship.) The California "voters responded angrily to the vivid television images of Mexican officials denouncing the measure and to the marchers in Los Angeles waving Mexican flags and protesting its limits on welfare benefits" (Schuck, 1995, p. 90). Proposition 187 is being challenged in court by opponents who claim it violates federal and state guarantees of equal protection, of state and federal privacy rights, and of international law. The federal courts have temporarily blocked the amendment as many U.S. citizens favor continuance of public benefits for illegal immigrants. California laws specifically give its citizens "a right to a basic education and the Legislature has a constitutional duty to provide one" (O'Halloran, 1994, p. 370).

Migrant workers and their families are in the midst of this battle. Schlosser (1995) cites the contribution of illegal immigration to the political and economic well being of California. Agriculture is California's largest industry and it now produces "more than half the fruits, nuts, and vegetables consumed in the United States" (Schlosser, 1995, p. 80). Schlosser maintains that 30% to 60% of the migrant workers in California are illegal immigrants, and that "illegal immigrants, widely reviled and depicted as welfare cheats, are in effect subsidizing the most important sector of the California economy" (p. 82). In fact, illegal immigrants are so essential to the U.S. agricultural economy that legislators often find ways to provide temporary guest worker programs for states that are dependent upon them. "Skillful manipulation of an increasingly vulnerable administrative system" (Schuck, 1995, p. 92) provides that the legal status of aliens "who enter surreptitiously should be called 'undocumented' rather than 'illegal' because their legal status remains uncertain for months or years during which the aliens can usually obtain work permits" (p. 92).

The stark truth is that the agricultural employment is a lifeline to migrant families. The cheap wages in the U.S. are up to 10 times the wages earned by Mexican peasants in their native villages. It is at a cost to Mexico and the United States. Mexico loses its surplus workers and the United States increasingly pays higher costs as migrants marry and raise children within the U.S. The Immigration and Naturalization Service "has traditionally rounded up and deported illegal immigrants in California immediately after the harvest" (Schlosser, 1995, p. 99). The workers who are overlooked often become American citizens and eventually find less physically demanding and more financially rewarding kinds of work in factories and other skilled trades. "As a result, the whole system now depends on a steady supply of illegal immigrants to keep farm wages low and to replace migrants who have either retired to Mexico or found better jobs in California" (p. 99).

The types of problems faced by migrant students are varied. Prewitt-Diaz (1991) lists four factors affecting migrant children in school: ecological, educational, psychological, and economical. Many families are seeking refuge from tyranny in their native countries. Others seek a better lifestyle and more job opportunities. Children move regularly from district to district, and experience absenteeism and falling behind in academic areas. Their self-image is affected as they struggle with their language and new relationships. Cultural differences create problems of inclusion within the classroom. Children are contributors in their families and "are essential in the economy of the migrant family" (Prewitt-Diaz, 1991, p. 485). They have power and may control their parent(s) as they become the interpreters between the school and the home. Romo (1993) lists similar problems, and adds that many secondary-age students have only attended grades 1-6 in Mexico. Velazquez (1994) describes their feeling of powerlessness combined with their respect for authority. Families have little formal education and trust the schools. They "feel that their questions about the appropriateness of their children's educational program will be construed as a challenge to the teacher's authority and prestige" (p. 33).

The impact of the migrant student on our schools is reflected by the rapid changes occurring in our public school population. Again, statistics differ. Estimates range from half a million to as many as 6 million migrant students enrolled in public education in the U.S. and Puerto Rico. Cahape (1993) reports there are over half a million migrant children enrolled in public education in the 50 states, the District of Columbia, and Puerto Rico. O'Halloran (1994) claims more than two million of those enrolled in public institutions in the last decade were immigrant youth, and 70% reside in just five states, "the majority having settled in California" (p. 371). Headden (1995) reports nearly three million students, mostly Latino, in the American educational system are designated as limited English proficient (LEP). Nearly 45% of these students live in California, and many of these children are migrant students. Trotter (1992) argues that many migrant children are unidentified and believes "estimates of all those engaged in migrant labor range between 1.7 million and 6 million" (p. 16).

The most accurate statistics may be kept by the Migrant Student Record Transfer System (MSRTS). MSRTS is a computerized information network used by approximately 17,000 sites in the U.S. that regulates and transfers data on migratory students as they move from school site to school site. MSRTS figures for 1990 show there are approximately 600,000 migrant children in the U.S. with the following concentrations: California (209,006), Texas (123,187), Florida (59,195), Washington (30,000), Arkansas (20,000), Oregon (20,000), New York (10,000), and the least, District of Columbia (190), and West Virginia (94).

The difficulty in compiling accurate statistics regarding migrant students is explainable. Federal program regulations require state Departments of Education to identify and educate migratory children. Authorized recruiters for the migrant student programs identify these students, but many students are not found. The California Handbook for Identification and Recruitment (California Department of Education, 1992) discusses the difficulty of finding children in rural settings who may be living temporarily in abandoned buildings, orchards, and cars.

The "culture of migrancy" (Velazquez, 1994, p. 32) contributes to the difficulty. Children assume adult roles in the fields, and "most migrant children drop out of school when they are able to work in the fields and earn money" (p. 33). The Migrant Student Record Transfer System (MSRTS) reports that the drop-out rate for migrant students is between 35% and 60%, and that most have dropped out by 10th grade. Overby (1993) reports dropout rates for migrant students of 43% as compared to Mexican-Americans of 35.8%. This reflects an improvement for migrant students over previous dropout rates as high as 90% in the 1970s (Cahape, 1993), however, and graduation rates have also increased. "Between 1984 and 1990, the number of migrant students enrolled in 12th grade climbed from 21,493 to 30,745--a 43% rise" (Trotter, 1992, p. 17). Trotter points out that most do not graduate, however, and that student enrollment had actually increased by 13% during the same period. He reports only 13.8% of migrant students graduate, compared to 87.8% of the general population, and 67.6% of the Latino population.

Grade level retention rates are also a problem. Migrant students are retained at grade level at least 1 year twice as often as the general population, largely due to academic deficiencies that result from problems associated with their lifestyle. MSRTS reports "33% are one year below grade level and 17% are two years or more below grade level" (Cahape, 1993).

The federal government remains dedicated to its commitment to migrant children and families as demonstrated by the government's blocking of Proposition 187 and other legislation. The Migrant Education Program was authorized in 1965 through the Elementary and Secondary Education Act. Federal program regulations require state Departments of Education to identify and educate migratory children. The California Department of Education assumes responsibility for all statutory and regulatory requirements of the program including subgrantees. Funding is based on a "Full-time Equivalent (FTE) count of each individual child for each day of residence in the State. This count is based upon the entry of data into the Migrant Student Record Transfer System (MSRTS) for each State for each year" (California Department of Education, Handbook, 1992, p. 1-2).

<u>California Portable Assisted Study Sequence (P.A.S.S.) Program.</u> The California Portable Assisted Study Sequence (P.A.S.S.) program is based in part on a newer Federal Law, P. L. 100-297, which was passed in 1988, and California Assembly Bill No. 1382, which was passed in 1981. This program serves 165 schools in California and serves as a national center for migrant student curriculum. P.A.S.S. is accredited through Fresno Unified School District, and the Western Association of Schools

and Colleges. The 1993-1994 National Report for the California Portable Assisted Study Sequence (P.A.S.S.) Program, which serves migrant students in California, shows it served 8,326 of the estimated 209,006 migrant students in California in 1993-1994. Nearly all of these students (8,243 or 99%) were Latino.

The program allows migrant students to carry portable work-text units from one school site to another. These courses are accepted as credits at participating school sites, and therefore, migrant students are able to transfer credits within the state and to at least twenty other states. The portable units can be continued at new school sites and students receive graduating credits. Therefore, the P.A.S.S. Program must not only provide materials that will be appropriate for the migrant student, but must also reflect mathematics reform standards.

The P.A.S.S. Handbook states that its courses "have the same content as the regular high school courses" (p. 2). The mathematics courses are sequential. The first courses in the sequence, written in 1989, are General Math A and General Math B. They were updated in 1995 as Integrated Math A and Integrated Math B. Other math courses include Consumer Math, Pre-Algebra, and Algebra A and Algebra B. A fifth course, Geometry is planned for late 1997. The Consumer Math course was rewritten in 1996-1997 as Consumer Education to integrate new reform ideas with career math into the program.

Methodology

Data sources

The curricular materials analyzed for this study were the 1989 P.A.S.S. curricula entitled General Math A and General Math B, and the 1995 P.A.S.S. curricula entitled Integrated Math A and Integrated Math B. The 1995 materials were developed to replace and update the 1989 materials in relationship to the goals and spirit of the National Council of Teachers of Mathematics Curriculum and Evaluation Standards for School Mathematics (1989).

Study Questions

Two questions addressed in this study were:

1. To what extent do the 1995 P.A.S.S. curricular materials improve upon the 1989 materials in reflecting reform ideas expressed in the Standards?

2. Can a researcher-designed evaluative instrument measure the extent to which curricular materials meet the Standards?

Instrumentation

An evaluative instrument was designed for this study to quantify the relationship between mathematics materials and the recommendations in the NCTM Standards. This instrument is entitled Mathematics Materials Analysis Instrument (MMAI) (Appendix A) and is divided into two grade levels: grades 5-8 and grades 9-12. The instrument is a modification of guides from those grade levels for the K-12 mathematics program found in A Guide for Reviewing School Mathematics Programs (NCTM, 1991). The modification process was accomplished through the joint efforts of the researcher and an expert validation panel consisting of three educators who are familiar with, and experienced in, the vision of the NCTM Standards.

The evaluative instrument MMAI consists of eight categories (with 3 to 12 subcategories each) for grades 5-8 and eight categories (with 6 subcategories each) for grades 9-12. The instrument includes an ordinal value scale: "1-None, 2-Low, 3-Moderate, 4-High." These ordinal values reflect the user's perception of the extent of alignment of content in the targeted curricular materials to reform standards delineated in the subcategories on MMAI.

Interrater reliability was established by measuring the extent to which similar ordinal values were assigned by various coders at separate locations using the evaluative instrument MMAI. This involved testing to see if there were significant differences in the coding assigned by two human coders (Coder 1 and Coder 2) and Nud*Ist computer coding (Coder 3) using MMAI on the 1989 and 1995 P.A.S.S. materials. The means of ordinal values assigned by each coder were computed and ranked for the 1989 and 1995 curricula at each grade level 5-8 and 9-12. The nonparametric Kruskal-Wallis H-test was then performed for each curriculum at each grade level, and no significant differences were found (Tables 1-2).

Table 1

Kruskal-Wallis H-test to Establish Interrater Reliability Between Coders Using the Mathematics Materials Analysis Instrument (MMAI) on 1989 Curriculum

MMAI Category	Coder 1	Rank	Coder 2	Rank	Coder 3	Rank
Grades 5-8						
A	2.08	11.5	2.08	11.5	2.17	13.0
B	1.71	4.5	1.86	6.5	1.86	6.5
C	2.25	16.0	2.25	16.0	2.25	16.0
D	2.44	20.0	2.22	14.0	2.56	21.0
E	2.40	19.0	2.60	22.5	2.60	22.5
F	1.71	4.5	2.00	9.0	2.29	18.0
G	1.00	2.0	1.00	2.0	1.00	2.0
H	2.00	9.0	2.00	9.0	3.33	24.0
	$N_1 = 8$		$N_2 = 8$		$N_3 = 8$	
		$R_{sum} = 86.5$		$R_{sum} = 90.5$		$R_{sum} = 123$

$H = 2.004$ $\alpha = .05$

MMAI Category	Coder 1	Rank	Coder 2	Rank	Coder 3	Rank
Grades 9-12						
A	1.83	13.0	2.17	22.0	2.33	24.0
B	1.67	9.0	2.00	18.0	1.83	13.0
C	2.00	18.0	2.00	18.0	1.50	6.5
D	1.83	13.0	1.83	13.0	2.17	22.0
E	1.33	5.0	1.17	4.0	1.50	6.5
F	1.67	9.0	1.83	13.0	2.17	22.0
G	1.00	2.0	1.00	2.0	1.00	2.0
H	2.00	18.0	1.67	9.0	2.00	18.0
	$N_1 = 8$		$N_2 = 8$		$N_3 = 8$	
		$R_{sum} = 87$		$R_{sum} = 99$		$R_{sum} = 114$

$H = 0.915$ $\alpha = .05$

Table 2

Kruskal-Wallis H-test to Establish Interrater Reliability Between Coders Using the Mathematics Materials Analysis Instrument (MMAI) on 1995 Curriculum

MMAI Category	Coder 1	Rank	Coder 2	Rank	Coder 3	Rank
Grades 5-8						
A	3.42	17.0	3.25	11.5	3.58	22.0
B	3.14	8.5	3.57	20.0	3.29	13.0
C	3.75	23.0	3.25	11.5	3.50	19.0
D	2.78	4.0	2.44	2.0	2.56	3.0
E	3.40	16.0	3.20	10.0	3.30	14.0
F	3.43	18.0	3.14	8.5	3.57	20.5
G	2.22	1.0	3.00	6.5	2.89	5.0
H	3.33	15.0	3.00	6.5	4.00	24.0
	$N_1 = 8$		$N_2 = 8$		$N_3 = 8$	
		$R_{sum} = 102.5$		$R_{sum} = 77$		$R_{sum} = 120.5$

$H = 2.389$ $\alpha = .05$

MMAI Category	Coder 1	Rank	Coder 2	Rank	Coder 3	Rank
Grades 9-12						
A	3.17	21.0	3.00	17.0	3.83	24.0
B	3.00	17.0	3.00	17.0	3.00	17.0
C	2.33	1.5	2.50	3.5	2.83	10.5
D	2.83	10.5	3.00	17.0	3.00	17.0
E	3.50	22.0	2.50	3.5	3.67	23.0
F	2.33	1.5	2.67	6.0	2.67	6.0
G	2.83	10.5	2.83	10.5	3.00	17.0
H	2.83	10.5	2.67	6.0	2.83	10.5
	$N_1 = 8$		$N_2 = 8$		$N_3 = 8$	
		$R_{sum} = 94.5$		$R_{sum} = 80.5$		$R_{sum} = 125$

$H = 2.589$ $\alpha = .05$

Content Analysis Methodology

This study utilized the methodology of content analysis. Triangulation (Kelle, 1995; Patton, 1990) in this study consisted of narrative descriptions and comparisons, manual data collection and coding, and computer analyses using Nud*Ist qualitative data analysis software (Richards & Richards, 1995).

The evaluative instrument designed for this study, Mathematics Materials Analysis Instrument (MMAI), (Appendix A) was used to obtain ordinal data from the 1989 and 1995 curricula. Coding was performed by three coders (two human coders and Nud*Ist computer coding). These data were converted to statistical measures of dispersion for analysis.

Data was collected from data collection worksheets and word sort lists containing frequency counts for each curriculum. These word lists were manually examined for key word-in-context listings, classifications of words into content categories, content category counts, and retrievals based on content categories and co-occurrences. The 1989 and 1995 curricula were also examined by comparing titles, subheadings, sections headings, student directions, and teacher guidelines. Discoveries made during this process led to further examination of classifications of words into content categories, content category counts, and other interpretative analyses (Krippendorff, 1980; Weber, 1990).

Findings and Conclusions

Nonparametric and qualitative analysis methods were used to analyze the data in the study and interpret the results.

Study Question 1: The first study question "To what extent do the 1995 P.A.S.S. curricular materials improve upon the 1989 materials in reflecting reform ideas expressed in the Standards?" was answered in several ways.

Chi-square analysis showed a statistically significant difference between the frequencies of ordinal value coding and the 1989 and 1995 curricula in relationship to the Standards (Table 3). Frequency counts for each of the three coders were computed from tallies of coded values on MMAI for the 1989 and 1995 curricula for each grade level 5-8 and 9-12. Total frequencies and expected values were calculated for each coder using 4x2 contingency tables. The null hypothesis was rejected at both grade levels.

Table 3

Chi-square Analysis of Observed and Expected Coding Values Using

Mathematics Materials Analysis Instrument (MMAI) on P.A.S.S. Curricula

Coding Value	Observed 1989	Observed 1995	Expected 1989	Expected 1995
Grades 5-8				
1	63	2	32.5	32.5
2	65	35	50.0	50.0
3	40	77	58.5	58.5
4	15	69	42.0	42.0
$X^2 = 112.66$ $\alpha = .05$ df = 3				
Grades 9-12				
1	73	17	45	45
2	42	25	33.5	33.5
3	20	56	38	38
4	9	46	27.5	27.5
$X^2 = 81.1$ $\alpha = .05$ df = 3				

The researcher examined the unit titles (Table 4) and tables of content that offered a cursory overview of contents in the 1989 and 1995 curricula. This examination further supported the findings that the 1995 curriculum was more aligned to the Standards than the 1989 curriculum.

Table 4

Unit Titles of P.A.S.S. Curricula

	Unit	Title	Unit	Title
1989 Course		General Math A	General Math B	
	I	Numeration Systems and Place Value	VI	Fractions
	II	Addition and Subtraction	VII	Decimals
	III	Multiplication	VIII	Percent
	IV	Division	IX	Measurement
	V	Application	X	Metrics
1995 Course		Integrated Math A	Integrated Math B	
	I	Number and Number Relationships	VI	Statistics and Probability
	II	Number Systems and Number Theory	VII	Algebra
	III	Computation and Estimation	VIII	Geometry
	IV	Patterns, Functions, and Math Connections	IX	Problem Solving
	V	Measurement	X	Mathematics as Communication

Descriptive statistics were used to explore the materials in more detail. Central measures of tendency were computed from data obtained from MMAI (Appendix A) for the 1989 and 1995 curricula (Tables 5-6). The 1989 data in Table 5 clearly show the mean and median measures centering around or below 2.0 with small standard deviations (with one exception). This indicates the coders agreed that the 1989 curriculum represented low levels of content relating to the NCTM Standards. Category H in grades 5-8 has an exceptionally high standard deviation of 0.77 compared to the other categories. Closer examination shows a higher rating by Nud*Ist that clearly affected this standard deviation. This proved to be true for most categories in both grade levels. This was not surprising because the computer does not *forget* data and the assignment of ordinal values is dependent upon memory. Human coders are more likely to forget specific details and therefore assign lower ordinal values on MMAI. At any rate, the group standard deviation remained small showing agreement between the three coders.

The 1995 data in Table 6 clearly show the mean and median measures centering around or above 3.0 with small standard deviations (with several exceptions). This indicates the coders agreed that the 1995 curriculum represented moderate levels of content relating to the NCTM Standards. Categories G and H in grades 5-8 have standard deviations of 0.42 and 0.51, and categories A and E have standard deviations of 0.44 and 0.63. These measurements are a little higher than the other standard deviations. Closer examination again shows a higher rating by Nud*Ist that clearly affected these standard deviations. Again, this seems to indicate the computer coding isolated more applicable text units than the human coders were able to observe and remember.

Figures 1-2 demonstrate the distributions of the group means data in Tables 5-6. The graphs confirm the interpretations made from the dispersion measurements. The distributions are fairly consistent and the scatterplots depict the higher ratings for the 1995 curriculum in grades 5-8 and 9-12.

Data collection worksheets provided frequency counts for three major categories: word problems, skill and drill problems, and projects and investigations. The category for skill and drill problems was chosen as highly representative of problems found in traditional mathematics courses. The category for word problems was chosen as representative of problems found in both traditional and integrated courses. The category for projects and investigations was chosen as indicative of problems requiring the higher-

Table 5

Measures of Dispersion for Coding Values on MMAI for 1989 P.A.S.S. Curriculum

MMAI Category	Coder 1 Mean	Coder 2 Mean	Coder 3 Mean	Group Mean	Standard Deviation
Grades 5-8					
A	2.08	2.08	2.17	2.11	0.05
B	1.71	1.86	1.86	1.81	0.09
C	2.25	2.25	2.25	2.25	0.00
D	2.44	2.22	2.56	2.41	0.17
E	2.40	2.60	2.60	2.53	0.12
F	1.71	2.00	2.29	2.00	0.29
G	1.00	1.00	1.00	1.00	0.00
H	2.00	2.00	3.33	2.44	0.77
Median	2.08	2.08	2.25	2.11	
Mean	1.95	2.00	2.26	2.07	0.17
Standard Deviation	0.47	0.46	0.67	0.50	

MMAI Category	Coder 1 Mean	Coder 2 Mean	Coder 3 Mean	Group Mean	Standard Deviation
Grades 9-12					
A	1.83	2.17	2.33	2.11	0.26
B	1.67	2.00	1.83	1.83	0.17
C	2.00	2.00	1.5	1.83	0.29
D	1.83	1.83	2.17	1.94	0.20
E	1.33	1.17	1.5	1.33	0.17
F	1.67	1.83	2.17	1.89	0.26
G	1.00	1.00	1.00	1.00	0.00
H	2.00	1.67	2.00	1.89	0.19
Median	1.67	1.83	1.83	1.83	
Mean	1.67	1.71	1.81	1.73	0.08
Standard Deviation	0.35	0.42	0.45	0.37	

Table 6

Measures of Dispersion for Coding Values on MMAI for 1995 P.A.S.S. Curriculum

MMAI Category	Coder 1 Mean	Coder 2 Mean	Coder 3 Mean	Group Mean	Standard Deviation
Grades 5-8					
A	3.42	3.25	3.58	3.42	0.17
B	3.14	3.57	3.29	3.33	0.22
C	3.75	3.25	3.50	3.50	0.25
D	2.78	2.44	2.56	2.59	0.17
E	3.40	3.20	3.30	3.30	0.10
F	3.43	3.14	3.57	3.38	0.22
G	2.22	3.00	2.89	2.70	0.42
H	3.33	3.00	4.00	3.44	0.51
Median	3.37	3.17	3.40	3.36	
Mean	3.15	3.09	3.30	3.18	0.11
Standard Deviation	0.51	0.34	0.47	0.37	

MMAI Category	Coder 1 Mean	Coder 2 Mean	Coder 3 Mean	Group Mean	Standard Deviation
Grades 9-12					
A	3.17	3.00	3.83	3.33	0.44
B	3.00	3.00	3.00	3.00	0.00
C	2.33	2.50	2.83	2.55	0.25
D	2.83	3.00	3.00	2.94	0.10
E	3.50	2.50	3.67	3.22	0.63
F	2.33	2.67	2.67	2.56	0.20
G	2.83	2.83	3.00	2.89	0.10
H	2.83	2.67	2.83	2.78	0.09
Median	2.83	2.75	3.00	2.92	
Mean	2.81	2.74	3.00	2.85	0.14
Standard Deviation	0.40	0.21	0.32	0.24	

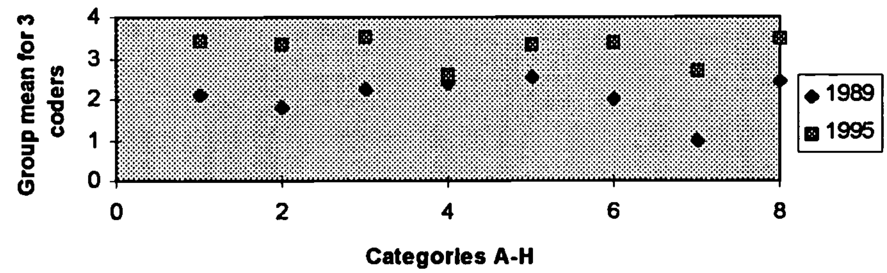

Figure 1: Distributions of coded values for grades 5-8 of P.A.S.S. curricula

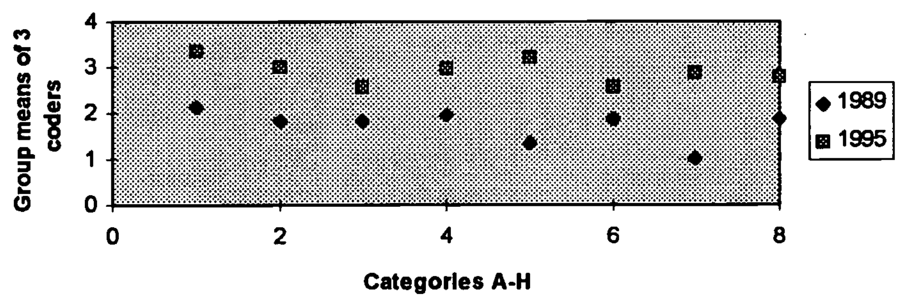

Figure 2: Distributions of coded values for grades 9-12 of P.A.S.S. curricula

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order-thinking processes envisioned in the Standards. Projects and investigations were combined into one category because they had similar requirements relating to time frames and critical thinking processes. Percents were computed and interpreted as showing the 1989 curriculum as largely traditional, and the 1995 curriculum as more adequately reflecting recommendations in the Standards (Table 7, Figures 3-4).

Word count lists were also analyzed for content categories relating to culture and gender. The findings support the vision of the Standards relating to these issues. The 1995 materials were measurably superior to the 1989 materials with respect to attention to Latino culture and male/female gender issues. The researcher concluded from all of these analyses that the 1995 P.A.S.S. materials measurably and qualitatively improve upon the 1989 P.A.S.S. materials in reflecting reform ideas expressed in the Standards.

Study Question 2: The second study question "Can a researcher-designed evaluative instrument measure the extent to which curricular materials meet the Standards?" was answered in terms of content validity and interrater reliability. The evaluative instrument Mathematics Materials Analysis Instrument (MMAI) (Appendix A) and supplementary attachments (Appendix B-D) were validated for content by a panel of three expert educators who are familiar with and experienced in the vision of the NCTM Standards.

The instrument was designed in the fall of 1995 and given to the content validation panel in January 1996. It was subsequently edited several times, and final panel validation was received in March 1996. The establishment of interrater reliability between human coders and computer coding in using the instrument on the study materials has already been discussed. In addition, a pilot study conducted with two different texts (Cummins, Kenney, & Kanold,1988; Rubenstein, Craine, & Butts, 1995) and five independent coders confirmed this reliability (Table 8). The tests found no significant differences at .05 level of significance between coders. This was true for two independent trials. The researcher concluded that coding was performed accurately and reliably by independent coders with the validated MMAI.

Table 7

Frequency Counts and Percentages of Types of Problems for P.A.S.S. Curricula

Year	Word Problems	Skill and Drill Problems	Projects and Investigations
1989	609	3866	-
1995	430	1124	195
As a percent of total problems			
1989	14%	86%	-
1995	25%	64%	11%

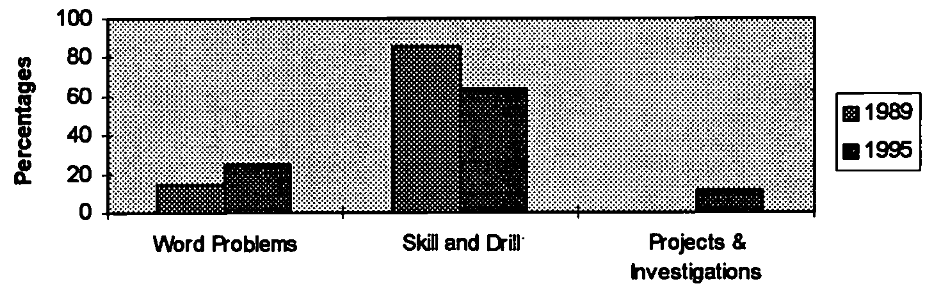

Figure 3: **Comparisons of types of problems in P.A.S.S. curricula.**

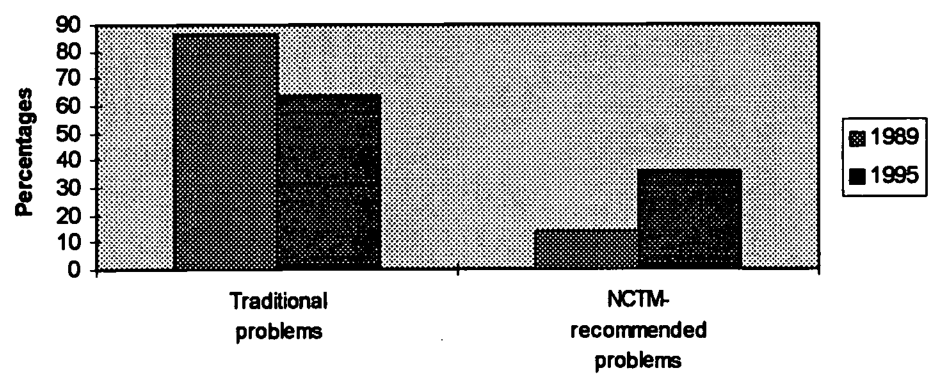

Figure 4: **Comparisons of combined types of problems from Figure 3 in P.A.S.S. curricula**

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Table 8

Kruskal-Wallis H-test to Establish Interrater Reliability Between Coders in Pilot Study

Using the Mathematics Materials Analysis Instrument (MMAI)

		Text A: Integrated Math				
MMAI Category	Coder 1	Rank	Coder 2	Rank	Coder 3	Rank
A	3.50	13.5	3.50	13.5	3.50	13.5
B	3.17	6.5	3.83	20.5	4.00	24.0
C	2.67	2.0	3.17	6.5	3.50	13.5
D	2.83	3.0	3.83	20.5	3.33	9.5
E	3.17	6.5	3.50	13.5	3.67	17.0
F	3.50	13.5	3.17	6.5	3.83	20.5
G	3.83	20.5	3.83	20.5	3.83	20.5
H	2.50	1.0	3.00	4.0	3.33	9.5
	$N_1 = 8$		$N_2 = 8$		$N_3 = 8$	
		$R_{sum} = 66.5$		$R_{sum} = 105.5$		$R_{sum} = 128$
$H = 4.841$ $\alpha = .05$						

		Text B: Informal Geometry				
MMAI Category	Coder 1	Rank	Coder 2	Rank	Coder 3	Rank
A	1.33	6.0	1.67	14.5	1.83	20.0
B	2.00	23.0	1.83	20.0	2.17	24.0
C	1.17	2.5	1.83	20.0	1.50	9.5
D	1.67	14.5	1.33	6.0	1.67	14.5
E	1.33	6.0	1.17	2.5	1.17	2.5
F	1.50	9.5	1.17	2.5	1.67	14.5
G	1.67	14.5	1.83	20.0	1.67	14.5
H	1.83	20.0	1.50	9.5	1.50	9.5
	$N_1 = 8$		$N_2 = 8$		$N_3 = 8$	
		$R_{sum} = 96$		$R_{sum} = 95$		$R_{sum} = 109$

$H = 0.305$ $\alpha = .05$

Conclusions

This study found the 1995 Portable Assisted Study Sequence (P.A.S.S.) curricular materials to be measurably superior to the 1989 curricular materials with respect to meeting Standards ideals and recommendations. It also affirmed that an evaluative instrument could be designed to effectively measure the extent to which mathematics curricular materials meet the Standards. The Mathematics Materials Analysis Instrument (MMAI) (Appendix A) designed for this study was proven to be reliable and able to effectively measure the P.A.S.S. curricula.

Significance of Findings

This study can benefit educators and society on many levels. The P.A.S.S. program is continuously updated, and this important first course of the mathematics sequence can provide direction to further curriculum developers. This can result in a new curriculum for migrant students designed around the concepts and transitions inherent in the NCTM Standards. This can have great impact nationally due to the role of the California P.A.S.S. office in providing direction and curriculum for the nation.

The evaluative instrument designed for this study (Appendix A) can be used as is, or can be revised and improved with further research. It can provide guidance and direction during the process of curriculum development as well as for curriculum selection. This can benefit teachers on a local, state, and national level.

Content analysis has not been used extensively in the mathematics education field, and this study can provide insights and direction for researchers wishing to utilize this methodology in mathematics education. The process for designing and validating the evaluative instrument can also have value to future researchers. This study succeeded in quantifying the subjective recommendations in the NCTM Standards, and this is also of value to educators and researchers on many levels.

This study is a beginning--the 1989 Standards are not the final document in mathematics reform. California is one of many states rigorously pursuing state standards in all core disciplines. The analysis of new curricular materials is essential in order to produce materials that meet newly recommended standards. This study demonstrates one way to measure the success of any reform efforts and can be beneficial across many disciplines. Significant curricular reform will have a significant social impact.

This study represents a pioneering effort to quantify changes in our mathematics curriculum through the design and introduction of the evaluative instrument, Mathematics Materials Analysis Instrument (MMAI) (Appendix A). Future research can improve the validity and reliability of this instrument through rigorous statistical treatments such as factor analysis, and more complex studies to improve interrater reliability and content validation. Interrater reliability studies using participants from dissimilar environments holding varied philosophical viewpoints could improve the reliability of MMAI. The instrument can be further streamlined, for example, by consolidation of categories. The study can be replicated with other curricular materials and in other disciplines to further strengthen its effectiveness and usefulness to education. The research design for this study can be used to analyze other educational issues. Finally, the power of fourth-generation content analysis software such as Nud*Ist has not been fully utilized in this study. Fourth-generation programs offer opportunities for qualitative theory building. Future researchers can unleash this power and build immensely on this pioneering study.

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Appendix A

Mathematics Materials Analysis Instrument (MMAI)

Adapted from A Guide for Reviewing School Mathematics Programs (1991)
National Council of Teachers of Mathematics (NCTM)

CURRICULUM
5-8

Problem solving, a central goal of the 5-8 curriculum, should focus on the analysis of situations and the posing of problems, on work with non-routine problems and problems with more than a single solution, and on the development of a variety of problem-solving strategies. Students' communications about mathematics must emphasize informal descriptions, the representation of ideas in various forms, and the use of the precise language and notation of mathematics. The transition from arithmetic to algebra should be accompanied by activities designed to promote the exploration of ideas in concrete settings and subsequent abstraction, generalization, and symbolization of those ideas.

CODING VALUES

TO WHAT EXTENT IS THIS REPRESENTED IN YOUR MATHEMATICS MATERIALS?

1-No = Not represented
2-Lo = Low level of representation
3-Mod = Moderate level of representation
4-Hi = High level of representation

Title:______________________________

Publisher:______________________________

Date of Publication:______________________________

No. of Pages:______________________________

No. of Chapters:______________________________

Supplementary Materials (e.g., student activity workbook, projects, etc.)

1. Title:______________________________
2. Title:______________________________
3. Title:______________________________

A. Problem Solving (Critical-Thinking Skills)

Learning to solve problems is the principal reason for studying mathematics. Problem solving is the process of applying previously acquired knowledge to new and unfamiliar situations. Solving word problems is one form of problem solving, but materials also should provide non-routine problems. Problem-solving strategies should include opportunities to pose questions, analyze situations, translate results, illustrate results, draw diagrams, and use trial and error. There should be alternative solutions to problems; problems should have more than a single solution.

To what extent does this happen in your materials?	None	Lo	Mod	Hi
1. Activities that promote original thinking are routinely encountered in the material.	1	2	3	4
2. The problem-solving process includes checks for reasonableness and completeness.	1	2	3	4
3. Topics are often applied to real-world situations.	1	2	3	4
4. Problems that are non- routine or require multi-step solutions are posed on a regular basis.	1	2	3	4
5. Situations are presented that require students to determine the problem; collect data ; use missing data, formulas, and procedures; and determine an acceptable solution.	1	2	3	4
6. Students use computer simulations to model and analyze complex situations.	1	2	3	4
7. Mathematical information routinely appears in various forms (e.g., tables, graphs, formulas, and functions).	1	2	3	4
8. Group problem solving is encouraged, with activities that promote students to share responsibility for the product of the activity and to discuss the results.	1	2	3	4
9. Activities are structured so that several strategies or techniques are available for use in the solution process	1	2	3	4
10. Activities are sequenced to guide student development from concrete instance to formal examinations.	1	2	3	4
11. Interdisciplinary projects and/or exercises are encouraged.	1	2	3	4
12. Activities encourage students to generalize results to other situations and subject-matter areas.	1	2	3	4

Compute the Sum of Coded Values by calculating sums for each column, and then finding the sum of those calculations. ___+___+___+___

_____Sum of Coded Values

Comments:

33

34

B. Communication

The 5-8 program should provide opportunities for students to develop and use the language and notation of mathematics. Vocabulary that is unique to mathematics and terms that have a common, as well as a mathematical, connotation should be used throughout the materials. Opportunities to express mathematical ideas by writing, speaking, making models, drawing diagrams, and preparing graphs should be provided.

To what extent does this happen in your materials?	None	Lo	Mod	Hi
1. Mathematical situations are represented or described in a variety of ways (e.g., verbal, concrete, pictorial, graphical, algebraic).	1	2	3	4
2. The understanding of mathematics is developed through open-ended activities and exercises which promote reflection, organization, and communication of ideas.	1	2	3	4
3. Activities and exercises are designed in such a manner that students are required to take positions on mathematical processes and defend their solutions through sound argument.	1	2	3	4
4. The need for formal mathematical symbolism is demonstrated.	1	2	3	4
5. The ability to read and analyze mathematics is emphasized.	1	2	3	4
6. The ability to write mathematics problems from real-world situations is emphasized.	1	2	3	4
7. Activities encourage students to demonstrate proper mathematical vocabulary and notation.	1	2	3	4

Compute the Sum of Coded Values by calculating sums for each column, and then finding the sum of those calculations. ___+___+___+___

_____Sum of Coded Values

Comments:

35

36

C. Computation

The 5-8 program should offer opportunities to compute with whole numbers, decimals, and fractions. Calculators or computers should be used for long, tedious computations. Additional mathematics topics should be provided for all levels of ability in addition to exercises promoting mastery of computational algorithms. Exercises should promote rapid approximate calculations using mental arithmetic and a variety of computational estimation techniques. When computation is needed, an estimate should be used to check reasonableness, examine a conjecture, or make a decision. Simple techniques for estimating measurements such as length, area, volume, and mass (weights) should be demonstrated. Appropriate levels of precision should be required.

To what extent does this happen in your materials?	None	Lo	Mod	Hi
1. Students are required to use pencil and paper to add, subtract, multiply, and divide decimals and fractions with common denominators.	1	2	3	4
2. A calculator is used to add, subtract, multiply, and divide more cumbersome fractions and decimals.	1	2	3	4
3. Computational algorithms are developed with an emphasis on having students understand the underlying principles (the whys).	1	2	3	4
4. Estimation is encouraged to check for reasonableness of computations (i.e., guess-and-check, mental arithmetic).	1	2	3	4

Compute the Sum of Coded Values by calculating sums for each column, and then finding the sum of those calculations. ___+___+___+___

_____Sum of Coded Values

Comments:

37

38

D. Measurement

Mathematics should be presented as having power, usefulness, and creative aspects so it is not viewed by students as a static, bounded set of rules and procedures to be memorized but quickly forgotten. When measurement is explored through rich, investigative, purposeful activity, it affords such opportunity. Fundamental concepts of measurement should be demonstrated through concrete experiences.

To what extent does this happen in your materials?	None	Lo	Mod	Hi
1. Basic units of measurement in the metric system and the relationships among those units of measurement--both within the dimension (e.g., length or volume)--are included.	1	2	3	4
2. Basic units of measurement in the English system and the relationships among those units within a dimension (e.g., feet in a yard or pints in a quart) are included.	1	2	3	4
3. Activities and exercises encourage students to select appropriate instruments to measure a dimension accurately.	1	2	3	4
4. Activities and projects encourage students to make and interpret scale drawings.	1	2	3	4
5. Activities and projects encourage students to develop and use procedures as well as formulas to determine area and volume.	1	2	3	4
6. Students are required to estimate measurements in both the metric system and the English system.	1	2	3	4
7. Student-developed systems of measurement are encouraged.	1	2	3	4
8. Concepts of perimeter, area, and volume are developed intuitively through the use of activities designed for counting units, covering surfaces, and filling containers.	1	2	3	4
9. Real-world activities encourage the use of measurements to generate student-collected data.	1	2	3	4

Compute the Sum of Coded Values by calculating sums for each column, and then finding the sum of those calculations. ___+___+___+___

_____Sum of Coded Values

Comments:

40

39

E. Number and Number Systems

A critical part of the middle school mathematics curriculum is a student's ability to generate, read, use, and appreciate multiple representations for the same quantity. A student's understanding of numerical relationships as expressed in ratios and proportions, equations, tables, graphs, and diagrams is of crucial importance in mathematics. Additionally, students need to understand the underlying structure of arithmetic. Emphasis must be placed on the reasons why various kinds of numbers (fractions, decimals, and integers) occur; on what is common among various arithmetic processes (how the basic operations are similar and different across sets of numbers--whole numbers versus fractions versus decimals, etc.); and on how one system relates to another (integers--an extension of whole numbers).

To what extent does this happen in your materials?	None	Lo	Mod	Hi
1. The sets of numbers are developed starting with the counting numbers and ending with the irrational numbers.	1	2	3	4
2. Numbers are understood to have several representations (fractions, decimals, etc.), and processes are available to convert from one to another.	1	2	3	4
3. Numbers are written as numerals, in words, and in expanded notation.	1	2	3	4
4. The relationship between a number (or set of numbers) and its graph(s) is emphasized.	1	2	3	4
5. The use of ratio and proportion is extended to cases that are different from the problems normally found in traditional materials (i.e., real-world applications, interdisciplinary topics, etc.).	1	2	3	4
6. The most appropriate form of a number is used in computation (i.e., scientific notation, decimal, fraction, percent, etc.)	1	2	3	4
7. Numbers with terminating, repeating, or non-repeating decimal forms are presented and used properly.	1	2	3	4
8. Number theory concepts such as prime numbers, GCF, LCM, and divisibility are introduced and developed.	1	2	3	4
9. Mathematics is viewed as a systematic development of a body of knowledge from a few accepted propositions by applying logical and procedural rules.	1	2	3	4
10. The concepts of relation and function are introduced and explored.	1	2	3	4

Compute the Sum of Coded Values by calculating sums for each column, and then finding the sum of those calculations. ___+___+___+___

_____Sum of Coded Values

Comments:

41

42

F. Geometry

Students should have knowledge of concepts such as parallelism, perpendicularity, congruence, similarity, and symmetry. They should know properties of simple plane and solid geometric figures and should be able to visualize and verbalize how objects move in the world around them using terms such as slides, flips, and turns. Geometric concepts should be explored in settings that involve problem solving and measurement.

To what extent does this happen in your materials?	None	Lo	Mod	Hi
1. The identification and description of geometric figures in 1, 2, and 3 dimensions are emphasized.	1	2	3	4
2. Opportunities to visualize, represent, and manipulate one-, two-, and three-dimensional figures are provided.	1	2	3	4
3. The relationships between geometric properties and other mathematical concepts are explored (i.e., similarity to ratio, congruence to equivalence, etc.).	1	2	3	4
4. Geometric relationships and their consequences are developed through non-classroom experiences and activities (i.e., research activities which explore community engineering projects, etc.).	1	2	3	4
5. Appreciation of geometry and its relationship to the physical world is developed.	1	2	3	4
6. Constructing, drawing, and measuring are used to further understanding of geometric properties.	1	2	3	4
7. Technology is used to explore geometric properties.	1	2	3	4

Compute the Sum of Coded Values by calculating sums for each column, and then finding the sum of those calculations.

___+___+___+___

_____Sum of Coded Values

Comments:

43

44

G. Probability and Statistics

Understanding probability and the related area of statistics is essential to being an informed citizen and is important in the study of many other disciplines. Students in grades 5-8 have a keen interest in trends in music, movies, and fashion and in the notions of fairness and the chances of winning games. These interests can be excellent student motivators for the study of probability and statistics.

To what extent does this happen in your materials?	None	Lo	Mod	Hi
1. Activities and projects encourage the systematic collection and organization of data.	1	2	3	4
2. Collections of data are represented and described by developing and using charts, graphs, and tables.	1	2	3	4
3. Exercises and activities are provided to demonstrate and analyze the likelihood of bias in a collection of data.	1	2	3	4
4. Predictions are made by interpolation or extrapolation from events or a given collection of data.	1	2	3	4
5. Basic statistical notions (e.g., measures of central tendency, variability, correlation, and error) are developed.	1	2	3	4
6. The concept of probability is developed and applied both in a laboratory (classroom) and in the real world.	1	2	3	4
7. Simulations and experiments are devised and conducted to determine empirical probabilities.	1	2	3	4
8. The role of probability is emphasized in situations of chance, insurance, weather, and other activities.	1	2	3	4
9. When students calculate from real data, the level of accuracy and the precision needed are emphasized.	1	2	3	4

Compute the Sum of Coded Values by calculating sums for each column, and then finding the sum of those calculations. ___+___+___+___

_____Sum of Coded Values

Comments:

45 46

H. Algebra

One of the most important roles of the middle grade mathematics curriculum is to provide a transition from arithmetic to algebra. It is crucial that students in grades 5-8 explore algebraic concepts in an informal way in order to build a foundation for the subsequent formal study of algebra.

To what extent does this happen in your materials?	None	Lo	Mod	Hi
1. A variety of mathematical representations (e.g., physical models, data, tables, graphs, matrices, etc.) are demonstrated and required in informal explorations with algebraic ideas (e.g., variable, expression, equation).	1	2	3	4
2. Concrete experiences with situations that allow students to investigate patterns in number sequences, make predictions, and formulate verbal rules to describe patterns are emphasized.	1	2	3	4
3. Students' use of algebraic concepts in applications is emphasized with a concurrent de-emphasis on routine algebraic manipulations.	1	2	3	4

Compute the Sum of Coded Values by calculating sums for each column, and then finding the sum of those calculations. ___+___ + ___ + ___

_____Sum of Coded Values

Comments:

47

48

Mathematics Materials Analysis Instrument (MMAI)

Adapted from A Guide for Reviewing School Mathematics Programs (1991)
National Council of Teachers of Mathematics (NCTM)

CURRICULUM
9-12

Problem solving should occur throughout all courses and should address the development of mathematical models of realistic situations. Many different activities, such as gathering data, exploring patterns, making and testing conjectures, and justifying conclusions through logical arguments, are necessary to develop students' mathematical reasoning and ability to communicate about mathematics. The availability of calculator and computer technology should reduce the emphasis on by-hand procedures for arithmetic computation and symbolic algebraic manipulation in the 9-12 curriculum. This should give additional opportunity to address topics such as probability and statistics, discrete mathematics, and spatial visualization.

CODING VALUES

TO WHAT EXTENT IS THIS REPRESENTED IN YOUR MATHEMATICS MATERIALS?

1-No = Not represented
2-Lo = Low level of representation
3-Mod = Moderate level of representation
4-Hi = High level of representation

Title:____________________

Publisher:____________________

Date of Publication:____________________

No. of Pages:____________________

No. of Chapters:____________________

Supplementary Materials (e.g., student activity workbook, projects, etc.)

1. Title:____________________
2. Title:____________________
3. Title:____________________

CURRICULUM: 9-12

A. Problem solving (Critical-Thinking Skills)

Learning to solve problems is the principal reason for studying mathematics. Problem solving is the process of applying previously acquired knowledge to new and unfamiliar situations. Solving word problems in texts is one form of problem solving, but materials should also contain non-routine problems. Problem solving involves posing questions, drawing diagrams, analyzing situations, using guess and check, and illustrating and interpreting results. Materials should provide opportunities for alternative solutions to problems, and problems with more than a single solution. Problems and applications should be used to stimulate the study of mathematical concepts

To what extent does this happen in your materials?	None	Lo	Mod	Hi
1. Problems are designed to introduce, develop, and review mathematical topics.	1	2	3	4
2. Concrete models are used to demonstrate realistic situations.	1	2	3	4
3. Activities and exercises encourage the use of a variety of problem-solving strategies to solve a broad range of problems.	1	2	3	4
4. Non-routine problems encourage the application of previous knowledge to unfamiliar situations.	1	2	3	4
5. The complexity of problem-solving is demonstrated through problems requiring more than one solution.	1	2	3	4
6. Exercises and activities are designed in such a manner as to encourage students to analyze incorrect solutions to identify errors in the problem-solving process.	1	2	3	4

Compute the Sum of Coded Values by calculating sums for each column, and then finding the sum of those calculations. ___+___+___+___

_____Sum of Coded Values

Comments:

52

51

B. Communication

The 9-12 program should give students opportunities to develop, learn, and use the language and notation of mathematics. Vocabulary that is unique to mathematics and terms that have a common, as well as a mathematical, connotation should be developed and used throughout the curriculum. Mathematical ideas should be expressed by writing, speaking, making models, drawing diagrams, and preparing graphs. Opportunities should be provided for discussing mathematical topics.

To what extent does this happen in your materials?	None	Lo	Mod	Hi
1. Activities, projects, and exercises encourage students to work in small groups.	1	2	3	4
2. Mathematical concepts are demonstrated with a variety of communication strategies (i.e., speaking, writing, drawing diagrams, graphing, and demonstrating with concrete models).	1	2	3	4
3. Symbolism and mathematical notation are demonstrated throughout the materials.	1	2	3	4
4. Exercises and activities encourage students to use appropriate symbols and mathematical notation.	1	2	3	4
5. Exercises and activities encourage students to use appropriate mathematical vocabulary.	1	2	3	4
6. Writing deductive arguments in paragraph form is encouraged.	1	2	3	4

Compute the Sum of Coded Values by calculating sums for each column, and then finding the sum of those calculations. ___+___+___+___

_____Sum of Coded Values

Comments:

54

53

C. Computation and Estimation

The 9-12 program gives students a variety of opportunities to gain facility in computing with whole numbers, decimals, and fractions and in using the four basic operations. It also provides opportunities for students to develop and use estimation skills and concepts on a continuing basis throughout the materials.

To what extent does this happen in your materials?	None	Lo	Mod	Hi
1. Choosing appropriate computational methods (mental arithmetic, paper-and-pencil algorithms, or calculating device) is emphasized in the materials.	1	2	3	4
2. Selecting the appropriate computation to be performed is stressed as well as performing the computations.	1	2	3	4
3. Activities and exercises encourage students to use estimation to judge reasonableness of results.	1	2	3	4
4. Activities and exercises encourage students to use estimation frequently as part of the problem-solving process.	1	2	3	4
5. Situations are presented for which the precision of results must be determined.	1	2	3	4
6. Activities and exercises encourage students to question the reasonableness of a solution to a problem as an important part of the problem-solving process.	1	2	3	4

Compute the Sum of Coded Values by calculating sums for each column, and then finding the sum of those calculations. ___+___+___+___

_____Sum of Coded Values

Comments:

56

55

D. Reasoning

Provision is made at all levels for introducing and using simple valid arguments. The 9-12 program gives students opportunities to learn the basic tenets of logical argument and to validate arguments. Connections among various representations of mathematical ideas are used to develop arguments.

To what extent does this happen in your materials?	None	Lo	Mod	Hi
1. Activities and exercises provide opportunities for listening and discussion.	1	2	3	4
2. Activities and exercises provide opportunities for exploration and questioning.	1	2	3	4
3. Activities and exercises provide opportunities for summarization and evaluation.	1	2	3	4
4. Activities and exercises provide opportunities to explore patterns.	1	2	3	4
5. Activities and exercises provide opportunities to make and test conjectures.	1	2	3	4
6. Activities and exercises are designed to teach students to follow and judge logical arguments.	1	2	3	4

Compute the Sum of Coded Values by calculating sums for each column, and then finding the sum of those calculations. ___+___+ ___+ ___

_____Sum of Coded Values

Comments:

58

57

E. Integration

The 9-12 program should provide integrated mathematics topics across the curriculum.

To what extent does this happen in your materials?	None	Lo	Mod	Hi
1. Function, as introduced in algebra, serves as a unifying concept across all mathematics courses (e.g., geometric transformations, trigonometric functions, and sequences).	1	2	3	4
2. The concepts of limit, maximum, and minimum are developed informally throughout the algebra strand.	1	2	3	4
3. The study of geometric properties is not restricted to formal geometry courses.	1	2	3	4
4. Discrete mathematics topics are included in the materials (i.e., finite graphs, matrices, sequences, series, combinations, permutations, and discrete probability).	1	2	3	4
5. Opportunities are provided in the materials to encourage students to collect, organize, and display data.	1	2	3	4
6. Activities and exercises promote the formulation of original problems which integrate mathematical content.	1	2	3	4

Compute the Sum of Coded Values by calculating sums for each column, and then finding the sum of those calculations. ___+ ___ + ___ + ___

_____Sum of Coded Values

Comments:

59

60

F. Interdisciplinary Emphasis

The 9-12 program should provide real-world applications in realistic situations. A variety of mathematical topics should be extended to other curricular areas.

To what extent does this happen in your materials?	None	Lo	Mod	Hi
1. Problems are chosen to integrate strands of mathematics with applications from other curricular areas.	1	2	3	4
2. Data from real-world situations are used to illustrate the properties of trigonometric functions.	1	2	3	4
3. Applications of probability in related fields such as business and sports are integrated into the materials.	1	2	3	4
4. Charts, tables, and graphs are used to draw inferences from real-world situations.	1	2	3	4
5. Students are required to apply statistical techniques to other subject areas.	1	2	3	4
6. The approach to computation reflects the ways in which computation is, and may be, used outside the school setting.	1	2	3	4

Compute the Sum of Coded Values by calculating sums for each column, and then finding the sum of those calculations. ___ + ___ + ___ + ___

_____ Sum of Coded Values

Comments:

61

62

G. Technology

The 9-12 program should use calculators and computers as tools for graphing, problem solving, performing tedious calculations, generating data, and developing concepts. Materials should allow students to appropriately choose calculators or computers to perform calculations that warrant their use.

To what extent does this happen in your materials?	None	Lo	Mod	Hi
1. The systematic use of calculators and/or computers to explore algebraic concepts reduces the need for paper-and-pencil graphing.	1	2	3	4
2. The use of the scientific calculator is encouraged to reduce the need for tables and pencil-and-paper interpolation skills.	1	2	3	4
3. Students are encouraged in the materials to use calculators and computers as tools in statistical investigations.	1	2	3	4
4. Students are encouraged in the materials to use calculators in daily work and on examinations.	1	2	3	4
5. Students are encouraged in the materials to use computers in daily work and on examinations.	1	2	3	4
6. Students are encouraged to use calculators to develop estimation skills and to check for reasonableness of results.	1	2	3	4

Compute the Sum of Coded Values by calculating sums for each column, and then finding the sum of those calculations. ___+___ + ___ + ___

_____Sum of Coded Values

Comments:

63

64

H. Other Curriculum Emphasis

There should be a change in the content emphasis in the secondary school curriculum. The strong emphasis traditionally placed on computational algorithms in the curriculum for non-college-bound students should give way to the inclusion of a broad range of studies, including problem solving, estimation, geometric concepts, applications, and mathematical reasoning. The program for college-bound students should integrate the same concepts and reduce the emphasis on algebraic manipulation skills. Lack of mastery of paper-and-pencil computation should not prohibit students from studying additional mathematics topics.

To what extent does this happen in your materials?	None	Lo	Mod	Hi
1. Opportunities are provided to study additional mathematics topics that do not require competence with paper-and-pencil computations.	1	2	3	4
2. The materials emphasize algebraic concepts such as linearity, function, equivalence, and solution.	1	2	3	4
3. Investigations and comparisons of various geometries are used to enhance the study of geometric concepts.	1	2	3	4
4. Materials encourage the use of three-dimensional figures to develop spatial skills.	1	2	3	4
5. Opportunities are provided for students to analyze the validity of statistical conclusions.	1	2	3	4
6. Opportunities are provided to analyze the uses and abuses of data interpretation.	1	2	3	4

Compute the Sum of Coded Values by calculating sums for each column, and then finding the sum of those calculations. ___+___ + ___ + ___

_____Sum of Coded Values

Comments:

65

66

Appendix B

Instructions for using Mathematics Materials Analysis Instrument (MMAI)

Materials on hand:

1) Scope and Summary of National Council of Teachers of Mathematics (NCTM) Standards - 6 pages
2) General Coding Rubric for Mathematics Materials Analysis Instrument (MMAI)
3) Mathematics Materials Analysis Instrument (MMAI)
   - Grades 5-8 (pp. 1-9)
   - Grades 9-12 (pp. 10-18)
4) Worksheet (pp. 1-4) with Example-Grades 9-12 (pp. 5-8)

1) Preview the above materials to understand the topics and areas involved in the NCTM Standards and the MMAI. The evaluator can refer to the reference materials listed below for further clarification.

2) Review the mathematics curricular materials and supplementary materials that are being evaluated to obtain a vision of the contents, and to provide insight into the scope and direction of the content and objectives.

3) Complete the MMAI. The General Coding Rubric should be used to help focus on general considerations that are part of the vision of the NCTM Standards. A coding value from 1 to 4 is circled on the instrument for each subcategory. The materials listed at the top of this page, the mathematics curricular materials, supplementary materials, and the reference materials listed below may be referred to as often as necessary during the completion of the instrument.

4) The worksheet is completed after the instrument is completed. *The Sum of coded values* for each category is transferred to the appropriate section on the worksheet. The worksheet provides details for calculating and interpreting the results.

Recommended reference materials:

Mathematical Sciences Education Board. (1989). Everybody counts. Sacramento, CA: Author.

National Council of Teachers of Mathematics. (1995). Assessment standards for school mathematics. Reston, VA: Author.

National Council of Teachers of Mathematics. (1995). Connecting mathematics across the curriculum. Reston, VA: Author.

National Council of Teachers of Mathematics. (1989). Curriculum and evaluation standards for school mathematics. Reston, VA: Author.

Appendix C

General Coding Rubric for Mathematics Materials Analysis Instrument (MMAI)

To what extent is this represented in your curriculum?

1-No	Not represented
2- Lo	Low level of representation
3-Mod	Moderate level of representation
4-Hi	High level of representation

The following considerations are important in determining which code is most applicable.

1 - No

- Traditional - non-integrated. Mathematics is presented in a linear fashion, i.e., Algebra, Geometry, Trigonometry, and so on.
- Rote learning, memorization, deductive reasoning is emphasized.
- Problems are close-ended; computational skills are emphasized.
- Calculators may be optional.
- Teacher is the expert and students are encouraged to work alone.
- The "decreased attention" topics are emphasized. (See "Scope and Summary of NCTM Standards - Summary of Changes in Content and Emphases).

2 - Lo

- Traditional - non-integrated. Mathematics is presented in a linear fashion, i.e., Algebra, Geometry, Trigonometry, and so on.
- Rote learning and memorization are emphasized but there is some flexibility.
- Problems are more complex and alternate solutions occasionally exist.
- Teacher is the expert but students are encouraged at times to work together.
- Computers and calculators are encouraged for computational exercises.

3- Mod

- Integrated mathematics curriculum (broad range of topics within mathematics).
- Students work periodically in cooperative groups.
- Projects, portfolios, manipulatives, and models are used to a limited degree.
- Computers and calculators are used for exploration as well as computational exercises.
- Students use several methods to communicate their ideas.
- The teacher and students share the "expert" role, but the teacher is the ultimate authority.

4- High

- Integrated mathematics curriculum (broad range of topics within mathematics).
- Interdisciplinary curriculum.
- Teacher is facilitator, provides resources, and introductory information.
- Students are team members, explorers, discoverers, and predictors.
- Computers, calculators (including graphing calculators), and multimedia are used extensively.
- Concrete models and manipulatives are available or are constructed by students to explore and refine ideas.
- Real-world applications are emphasized; students are encouraged to explore in their own community.
- Projects and investigations replace rote exercises.
- Students learn to compute through rote exercises but quickly advance to more complex ideas and problems.
- Problems emphasize open-ended responses.
- Students use a variety of communication methods.

Appendix D

WORKSHEET for Coding MMAI

Title: ____________________
Publisher: ________________
Date of Pub.: ______________

Enter the *Total Sums of Coded Values* from each subcategory on the MMAI to the appropriate curriculum section Grades 5-8 or 9-12.

No. of Items	Curriculum: 5-8	Sum of Coded Values
12	A. Problem Solving (Critical-Thinking Skills)	____
7	B. Communication	____
4	C. Computation	____
9	D. Measurement	____
10	E. Number and Number Systems	____
7	F. Geometry	____
9	G. Probability and Statistics	____
3	H. Algebra	____
61		
	Total:	____

No. of Items	Curriculum: 9-12	Sum of Coded Values
6	A. Problem Solving (Critical-Thinking Skills)	____
6	B. Communication	____
6	C. Computation and Estimation	____
6	D. Reasoning	____
6	E. Integration	____
6	F. Interdisciplinary Emphasis	____
6	G. Technology	____
6	H. Other Curriculum Emphasis	____
48		
	Total:	____

CALCULATIONS and INTERPRETATIONS

This instrument can be used by one evaluator or by a team of two or more evaluators. The calculations in subheading I apply to both cases. The calculations in subheading II are to be used for two or more evaluators and should be made in addition to those made in subheading I.

I: One Evaluator:

Finding the mean ($\bar{x}$) for all categories:
T = Total Sum of Coded Values

A = No. of Applicable Items:
[Grades 5-8: (A = 61) or Grades 9-12: (A = 48)]

Enter the sums from the worksheet:

T = _______ A = _________

$\bar{x} = \frac{T}{A} =$ _________ (to at least 3 decimal places)

Interpretation: The mean indicates the degree of movement toward the Standards. Compare it to the Coding Values: 1 = None; 2 = Low; 3 = Moderate; 4 = High.
Conclusions:____

____

____

Finding the mean for each subcategory: Further statistical tests can be done on each subcategory. The easiest comparisons can be made by simply finding the median and mean of each subcategory and comparing them to the Coding Values: 1 = None; 2 = Low; 3 = Moderate; 4 = High. This is a quick check to find weaknesses and strengths within the categories. (For Grades 9-12, use the formula shown below. For Grades 5-8, refer to page 1 of the worksheet and change the 6 in the formula to match the number of items in each subcategory.)

$$\frac{\textit{Sum Coded Values}}{6} = \textit{Mean}$$

Conclusions:

	Formula		Mean
A		=	____
B		=	____
C		=	____
D		=	____
E		=	____
F		=	____
G		=	____
H		=	____

Interpretation:
Categories with means above 3.0 can be seen to be moving toward the Standards and can be compared to the Coding Values: *3 - Moderate* and *4 - High*. Categories below 3.0 can be compared to the Coding Values: *1 - None*, *2 - Low* and *3 - Moderate*. The materials will need to be supplemented in these categories with activities and exercises reflecting higher movement toward the Standards. Coding Values for each item can be examined in these categories to help in determining the type of supplementary activities that will be needed.

II: Two or More Evaluators:

Finding the mean ($\overline{X}$) and Standard Deviation (SD or σ) for all categories:

n = number of evaluators

$i = 1, 2, 3, \ldots n$

T_i = Total Sum of Coded Values for Evaluator i

A_i = No. of Applicable Items for Evaluator i:
[Grades 5-8: (A_i = 61) or Grades 9-12: (A_i = 48)]

i	T_i	A_i
1	____	____
2	____	____
3	____	____
4	____	____
...	____	____
n	____	____
Total	____ T_s	____ A_s

$$T_s = \sum_{i}^{n} T_i \qquad A_s = \sum_{i}^{n} A_i$$

T_s = ________ A_s = ________

$\overline{X}$ (group mean) : $\frac{T_s}{A_s}$ = ________ (to at least 3 decimal places)

$x_i = \overline{x}$ (mean) from calculations in Part I for each evaluator

$$\sigma = \sqrt{\frac{\sum_{i}^{n} (x_i - \overline{X})^2}{n-1}}$$

σ = ________

Interpretation:
The mean indicates the degree of movement toward the Standards. Compare it to the Coding Values: 1 = None; 2 = Low; 3 = Moderate; 4 = High.
Conclusions:____

II. Continued

The standard deviation (SD or σ) measures the distribution of data in relationship to the mean. A small SD indicates the *total sum of coded values* are close together which means the evaluators are in close agreement in their opinions of the materials. A large SD indicates that *the total sum of coded values* are spread out which indicates the evaluators are not in close agreement in their opinions of the materials.

The mean and SD also indicate the percentage of values in a normal distribution:

$\overline{X} \pm$ 1.0 SD = approximately 68% of the total coded values

$\overline{X} \pm$ 2.0 SD = approximately 95% of the total coded values

$\overline{X} \pm$ 2.5 SD = approximately 99% of the total coded values

$\overline{X} \pm$ 3.0 SD = approximately 99+% of the total coded values

Conclusions:____

EXAMPLE - Grades 9-12

WORKSHEET

Title: INTEGRATED MATH
Publisher: XYZ PUBLICATIONS
Date of Pub.: 1995

Enter the *Total Sums of Coded Values* from each subcategory on the MMAI to the appropriate curriculum section Grades 5-8 or 9-12.

No. of Items	Curriculum: 5-8	Sum of Coded Values
12	A. Problem Solving (Critical-Thinking Skills)	____
7	B. Communication	____
4	C. Computation	____
9	D. Measurement	____
10	E. Number and Number Systems	____
7	F. Geometry	____
9	G. Probability and Statistics	____
3	H. Algebra	____
61		
	Total:	____

No. of Items	Curriculum: 9-12	Sum of Coded Values
6	A. Problem Solving (Critical-Thinking Skills)	21
6	B. Communication	16
6	C. Computation and Estimation	15
6	D. Reasoning	17
6	E. Integration	18
6	F. Interdisciplinary Emphasis	17
6	G. Technology	22
6	H. Other Curriculum Emphasis	15
48		
	Total:	141

EXAMPLE - Grades 9-12

CALCULATIONS and INTERPRETATIONS

This instrument can be used by one evaluator or by a team of two or more evaluators. The calculations in subheading I apply to both cases. The calculations in subheading II are to be used for two or more evaluators and should be made in addition to those made in subheading I.

I: One Evaluator:

Finding the mean $\bar{x}$ for all categories:

T = Total Sum of Coded Values

A = No. of Applicable Items:
[Grades 5-8: (A = 61) or Grades 9-12: (A = 48)]

Enter the sums from the worksheet:

T = *141* A = *48*

$$\bar{x} = \frac{T}{A} = 2.938$$ (to at least 3 decimal places)

Interpretation: The mean indicates the degree of movement toward the Standards. Compare it to the Coding Values: 1 = None; 2 = Low; 3 = Moderate; 4 = High.

Conclusions: *This material is moving toward the* Standards *as indicated by the mean of 2.938 compared to* 2.0 - Low and 3.0 - Moderate.

Finding the mean for each subcategory: Further statistical tests can be done on each subcategory. The easiest comparisons can be made by simply finding the mean of each subcategory and comparing it to the Coding Values: 1 = None; 2 = Low; 3 = Moderate; 4 = High. This is a quick check to find weaknesses and strengths within the categories.

$$\frac{\text{Sum Coded Values}}{6} = \text{Mean}$$

	Formula		Mean
A	21/6	=	3.50
B	16/6	=	2.67
C	15/6	=	2.50
D	17/6	=	2.83
E	18/6	=	3.00
F	17/6	=	2.83
G	22/6	=	3.67
H	15/6	=	2.50

Conclusions:

Categories A, B, E, F, and G are moving toward the Standards *and can be compared to the coding values 3 -* Moderate *and* 4 - High. *Categories B,C, D, F, and H can be compared to the Coding Values:* 2 - Low and 3 - Moderate. *The materials will need to be supplemented with activities and exercises reflecting higher movement toward the* Standards *in these categories. Further examination of the items in each category will indicate the specific areas to be targeted.*

Interpretation:

Categories with means above 3.0 can be seen to be moving toward the Standards and can be compared to the Coding Values: *3 - Moderate* and *4 - High*. Categories below 3.0 can be compared to the Coding Values: 1 - *None*, 2 - *Low*, and 3 - *Moderate*. The materials will need to be supplemented in these categories with activities and exercises reflecting higher movement toward the Standards. Coding Values for each item can be examined in these categories to help in determining the type of supplementary activities that will be needed.

EXAMPLE - Grades 9-12

II: Two or More Evaluators:

Finding the mean ($\overline{X}$) and Standard Deviation (SD or σ) of all categories:

n = number of evaluators

$i = 1, 2, 3, \dots n$

T_i = Total Sum of Coded Values for Evaluator i

A_i = No. of Applicable Items for Evaluator i:

[Grades 5-8: ($A_i = 61$) or Grades 9-12: ($A_i = 48$)]

(For purposes of this example, assume three additional worksheets for Calculation I (Grades 9-12) have been completed for three additional evaluators. The totals for T_i *are entered from the four worksheets).*

i	T_i	A_i
1	141	48
2	166	48
3	126	48
4	175	48
Total	608 T_s	192 A_s

$$T_s = \sum_{i}^{n} T_i \qquad A_s = \sum_{i}^{n} A_i$$

T_s = 608 $\qquad$ A_s = 192

$\overline{X}$ (mean) : $\frac{Ts}{As}$ = 3.167 (to at least 3 decimal places)

x_i = $\overline{x}$ (mean) from calculations in part I for each evaluator

For purposes of this example, assume the calculated means x_i *are as follows:*

$x_i = 3.065$ $\qquad$ $x_2 = 3.458$ $\qquad$ $x_3 = 2.930$ $\qquad$ $x_4 = 3.723$

$$\sigma = \sqrt{\frac{\sum_{i}^{n} (x_i - \overline{X})^2}{n-1}}$$

σ = 0.39

Interpretation:

The mean indicates the degree of movement toward the Standards. Compare it to the Coding Values: 1 = None; 2 = Low; 3 = Moderate; 4 = High.

Conclusions: *This material is moving toward the* Standards *as indicated by the mean of 3.167 as compared to* 3.0 - Moderate *and* 4.0 - High.

EXAMPLE - Grades 9-12

II: Two or More Evaluators (Continued):

The standard deviation (SD or σ) measures the distribution of data in relationship to the mean. A small SD indicates the *total sum of coded values* are close together which means the evaluators are in close agreement in their opinions of the materials. A large SD indicates that *the total sum of coded values* are spread out which indicates the evaluators are not in close agreement in their opinions of the materials.

The mean and SD also indicate the percentage of values in a normal distribution:

$\overline{X} \pm$ 1.0 SD = approximately 68% of the total coded values

$\overline{X} \pm$ 2.0 SD = approximately 95% of the total coded values

$\overline{X} \pm$ 2.5 SD = approximately 99% of the total coded values

$\overline{X} \pm$ 3.0 SD = approximately 99 + % of the total coded values

Conclusions: *The mean 3.167 ± 0.39 = 3.557 or 2.778. This means 68% of the total coded values are between 2.778 and 3.557. These values can be compared to the Coding Value:* 3 - Moderate. *Furthermore, the mean 3.167 ± 2.0 SD = 3.167 ± 2.0 x 0.39 = 3.947 or 2.387. This means 95% of the total coded values are between 2.387 and 3.947. The materials therefore seem to be moving toward the* Standards.

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