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Perceptions and Application of NCTM Standards by Special and General Education Teachers

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ABSTRACT: *This study determined teachers' perceptions related to application of, and barriers to implementation of the National Council of Teachers of Mathematics (NCTM) Standards with students labeled learning disabled (LD) and emotionally disturbed (ED). A stratified random sample of 129 secondary general education math and special education teachers responded to a mail survey. A majority of special education teachers indicated they had not heard of the NCTM Standards. Respondents reported teaching mostly basic skills/general math to secondary students with LD and ED, versus higher-level math, such as algebra and geometry. Teachers identified lack of adequate materials as a considerable barrier to successful implementation of activities based on the Standards. Implications for practice and future research are also provided.*

Standards-driven reform is the primary approach to assuring today's high school graduates are internationally competitive. Prompted by the public dissatisfaction and poor performance by U.S. students on international assessments (McLaughlin, Shepard, & O'Day, 1995), educators, curriculum specialists, and national organizations have focused on development of challenging standards for over a decade. Recent legislation (i.e., Goals 2000; Improving America's Schools Act; Individuals with Disabilities Education Act) has assisted these efforts and assured that students with disabilities are included, to the maximum extent possible. Central to this notion of reform is the assertion that all students are "entitled to instruction that is grounded in a common set of challenging standards" (McLaughlin, 1999, p. 10).

Rigorous standards are especially crucial for students with learning disabilities (LD) and emotional disorders (ED), who compose 72% (n = 2,002,314); (U.S. Department of Education, 2000) of the secondary students in special education and are commonly included in the general education environment. These students have historically been provided a less rigorous curriculum with individualized education program (IEP) goals that focus on computation (Shriner, Kim, Thurlow, & Ysseldyke, 1993) and have minimal linkage to long-term general education outcomes (Nolet & McLaughlin, 2000; Sands, Adams, & Stout, 1995; Smith, 1990). In the sections that follow, the National Council of Teachers of

Mathematics (NCTM) Standards are discussed relative to standards-based reform efforts and students with disabilities, followed by a review of relevant characteristics of students with LD and ED. Finally, the purpose of the study is delineated.

The NCTM Standards are a critical component of the Standards-driven reform movement.

NCTM AND REFORM EFFORTS

The NCTM is one of the national organizations that have produced a comprehensive approach to applying standards-driven reform. In 1989, a community of math educators and other professionals developed the Standards in an effort to address the low math performance of students in the United States. The NCTM Standards are guided by five main goals that encompass the "spirit" of the Standards, wherein students (a) become better problem solvers, (b) learn to reason mathematically, (c) learn to value mathematics, (d) become more confident in their mathematical ability, and (e) learn to communicate mathematically (NCTM, 1989). These goals reflect changes in math curriculum, assessment, and professional teaching practices (NCTM 1989; 1991; 1995; 2000) to help all students achieve in mathematics. In contrast to past reform efforts (e.g., Back to Basics) that narrowly focused on the acquisition and retention of basic math skills, NCTM Standards address problem-solving and reasoning skills deemed essential for an increasingly technological society and future employment.

Specifically, the focus of the Standards is on conceptual understanding rather than procedural knowledge or rule-driven computation. Student understanding of mathematical concepts is promoted via active engagement with manipulatives or concrete objects, applying math to real-world situations, group work and discussions, and teacher facilitation. This approach to mathematics education is supported by recent analysis of data from the Third International Mathematics and Science Study (TIMSS). Based on the data, researchers (National Institute on Educational Governance, Finance, Policymaking, and Management, 1998) indicate that the problem with U.S. student performance is not basic mathematical computation, but advanced mathematical concepts and problem-solving.

The NCTM Standards are a critical component of the Standards-driven reform movement. Although no current count exists that identifies the number of states that have adopted state standards consistent with those set forth by NCTM, Blank and Dalkilic (1992);(as noted in Thurlow, 2000) report that 42 states have used the Standards as a guide to development of mathematics standards. Researchers (Rivera, Taylor, & Bryant, 1994/1995) also assert that all students, including those with disabilities, should be taught areas identified in the Standards. This is becoming more of a reality as students with disabilities are being educated in the general education classroom and are exposed to the same curricula as their peers without disabilities. Further, it is a requirement in some states for students to pass assessments with open-ended problem-solving tasks that are in line with the Standards in order to receive a diploma (e.g., Maryland State Department of Education, 2000).

Characteristics of Students with LD and ED

Students with LD and ED exhibit several common academic and behavioral characteristics (Anderson, Kutash, & Duchnowski, 2001; Scruggs & Mastropieri, 1986) that may affect success in NCTM Standards-based mathematics activities. In addition to performing approximately two grade levels behind peers without disabilities (Wagner, 1995), significant characteristics affecting performance for both groups include difficulty attending to key dimensions of tasks (Kauffman, 2001) and deficits employing metacognitive strategies (Bricklin & Gallico, 1984; Gallico, Burns, & Grob, 1991). Also, typical instructional approaches may combine with student learning and behavioral characteristics and affect student academic success (Marolda & Davidson, 1994). For example, the common em-

phases on computational skills and fact memorization, coupled with a limited exposure to problem-solving, may negatively impact these students. Such ramifications may be observed within subsequent classes where teachers utilize a problem-solving-based approach to math education (Baroody & Hume, 1991; Bos & Vaughn, 1994; Salend & Hofstetter, 1996) and also in contexts outside of school.

Researchers also note relevant characteristics more specific to students labeled LD. Many adolescents with LD experience math difficulties (McLeod & Armstrong, 1982), particularly in problem application, and generally perform at the fifth-grade level in math (Cawley & Miller, 1989). These students typically approach complex math tasks, such as multistep word problems, in a notably different way than students proficient at problem-solving. For instance, many students with LD experience problems: (a) selecting and employing appropriate operations during problem-solving (Montague & Bos, 1990), (b) representing problem-solving situations (Montague, Bos, & Ducette, 1991), and (c) selecting relevant information in problems (Blankenship & Lovitt, 1976).

Adolescents with ED also possess characteristics that differentiate them from peers without disabilities and, to a lesser extent, from students with LD. For example, the academic success or failure of students labeled ED is greatly affected by the extent to which instruction is functional and recognized by students as relevant (Bos & Vaughn, 1994). In addition, these students often exhibit a general lack of persistence and concentration and have difficulties with independent class work. Further, results of two studies (Carr & Punzo, 1993; Hogan & Prater, 1993) indicate that students with ED obtain a correct rate of between 20% and 76% on independent seatwork (Guntner & Denny, 1998). The ability of students to persist and work independently on open-ended mathematical tasks could greatly affect the level of success experienced in light of the more constructivist approach that guides the NCTM Standards.

Teacher Beliefs of NCTM Standards With Students With LD and ED

In addition to academic and behavioral characteristics of students labeled LD and ED, certain teacher beliefs, such as familiarity and confidence with implementing the Standards, may also affect successful implementation of Standards-based activities. For example, Manouchehri (1998) noted that teachers who lack familiarity with conceptually-based questioning techniques rarely expect students to elaborate, justify their position, or support students in the systematic testing of opposing approaches to mathematical problems. Similarly, NCTM (1991) acknowledges that teacher confidence affects both what is taught and the instructional approach used by teachers. Although there is widespread use of the NCTM Standards (Parmer & Cawley, 1995), no information is available that addresses secondary special and general education teacher familiarity and confidence with the standards with students with disabilities.

To achieve a clear understanding of secondary general and special educator confidence and familiarity with the NCTM Standards, student response to standards-based activities and barriers to implementation should also be considered. For example, Manouchehri (1998) noted that teacher beliefs and practices are strongly influenced by leadership at the school and district levels. Additionally, researchers (Reys, Reys, Barnes, Beem, & Papick, 1998) have identified obstacles to Standards-based reform efforts, including (a) teacher views and beliefs of mathematics that may influence practice (e.g., traditional view of math as facts and formulas, tracking students in math by ability level), and (b) initial student reactions to the new curricula that require more critical thinking and problem-solving skills than students may have experienced in past math courses.

PURPOSE

To date, no studies investigate secondary teacher familiarity with the NCTM Standards, confidence with implementation, barriers to successful implementation, and student response to Standards-based activities. Nor is there research on

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these topics for general and special educators who teach students with LD and ED. This is unfortunate given that common, rigorous standards are the catalysts for improved educational outcomes within standards-based reform (Gagnon, McLaughlin, Rhim, & Davis, in press; McDonnell, McLaughlin, & Morison, 1997). Identification of these factors is essential to assess teacher perception of preparedness and ability to implement Standards-based activities within the school context. Thus, our current study determined teacher perceptions related to implementation of the Standards with secondary students labeled LD and ED. A survey for general and special educators in Maryland secondary schools was designed to answer the following research questions:

1. How familiar are special and general education teachers with the goals of the NCTM Standards?
2. How confident are special and general education teachers in their ability to teach math relative to the goals of the NCTM Standards?
3. According to teachers, how favorably do students with LD and ED respond to activities, lessons, and strategies that incorporate the recommendations of the NCTM Standards?
4. What are perceived barriers to successful Standards implementation for students with LD and ED?
5. Do teachers' responses differ according to age, gender, years of teaching experience, grade levels taught, training, locale, position, and teaching load?

METHODOLOGY

Instrumentation

Based on a review of literature, the authors identified four central topics as the focus of the current survey: (a) general background information (e.g., years teaching experience, type of mathematics courses currently teaching, number of special education methods courses taken), (b) implementation of the Standards with students labeled LD and ED (e.g., familiarity with the Standards, confidence implementing Standards-based activities, teacher perception of student response to Standards-based activities), (c) barriers to implementation of Standards-based activities (e.g., lack of materials, lack of administrative support), and (d) nature of adaptations of the Standards to meet the needs of students with LD and ED. In addition to the categorical and ordinal questions contained in each of the first four sections, the fourth and fifth sections included open-ended questions (e.g., list two advantages of implementing the NCTM Standards with students with emotional/behavioral disorders);(see Maccini and Gagnon, 2000, for the results of the open-ended questions) related to implementation of activities based on the Standards.

The survey was developed via a four-step process. Based on a review of literature an initial version of the survey was constructed focusing on teaching math to secondary students with LD and ED. Second, a review board that included leaders in the fields of special education and math education examined the survey. Third, a focus group of educators provided feedback on the survey questions and design. The authors made appropriate revisions following each stage. To address issues specific to general and special educators, two versions of the survey were constructed and mailed to teachers. A majority of the questions on both surveys were the same. However, the special education survey included 14 questions that applied solely to those teachers (e.g., number of students on caseload). Similarly, the survey designed for general educators also included questions (n = 12) relevant only to them (e.g., average number of students in your math classes).

Reliability. To address possible threats to reliability and enhance replicability of research findings, survey data collection procedures were closely followed (Fink, 1995; Yin, 1994). For example, standardized directions were incorporated into the survey instrument. Further, a reliability check was conducted on 25% of survey questions to assess the researchers' fidelity with data entry

and was determined to have a 99% reliability rate. This agreement was calculated by the following formula: number of agreements divided by number of agreements and disagreements times 100. To further establish reliability, Cohen's Alpha was calculated to determine the internal consistency of items addressing barriers to implementation of the NCTM Standards (n = .724).

Validity. Threats to validity were addressed to maximize the quality of the surveys and improve the generalizability of findings. To address construct validity, a focus group and advisory panel were developed prior to study implementation. The focus group consisted of secondary general and special education math teachers. These professionals offered feedback and recommendations in three areas: (a) accuracy of targeted objectives, (b) necessary question additions/deletions, and (c) clarification of questions and format. The advisory panel included experts in the fields of math education, statistics, and learning disabilities. This panel examined the survey instruments and also reviewed the methodology of the study. Modifications were made based on the recommendations of these two groups.

SAMPLE

Survey Sampling Procedures. The state of Maryland was selected for the study as the 24 school districts are representative of a national range of geographical locations (urban, suburban, and rural), as well as student population densities (0-599, 600-600, and 1,000 or more students). For example, 88% of students in Maryland are served in urban schools and 3% in suburban schools versus national averages of 71% and 12%, respectively. Also, the percentages of identified students in Maryland approach national statistics. For example, 11% (n = 4,933) of students in Maryland were labeled with serious emotional disturbance versus 11% (n = 275,485) nationally. Further, 5.19% of children ages 6-17 in Maryland were labeled with a specific learning disability during the 1997/1998 school year. This was close to the national average of 5.61%.

The following sampling procedures were followed for inclusion in this study: (a) a list of all Maryland school districts was identified using the Common Core of Data (National Center for Education Statistics, 1995); (b) initial contact was made via phone with administrators and supervisors of special education from each of 24 Maryland districts; and (c) the administrators in the districts willing to participate (n = 17) were mailed a description of the study, survey, and a request for all public school secondary (i.e., Grades 6-12) mathematics teachers and special educators who were currently teaching mathematics in the general education setting or in exclusionary programs (i.e., resource room and self-contained class). If more than two special education teacher names and two general educator names were provided per school, a two-stage cluster procedure (Fink, 1995; Fowler, 1988) was used. Teacher names were randomized and chosen in sequential order, and surveys were mailed to the targeted teachers, with 143 mailed to special educators and 182 to general educators, for a total of 325.

Response Rate. A total of 39 surveys were excluded from the analysis due to one of five concerns: (a) teachers were not instructing students labeled LD or ED (n = 4), (b) teachers changed schools from the initial to follow-up mailings (n = 29), (c) incorrect school address (n = 3), (d) the wrong survey was mailed to the teacher (n = 1), or (e) the survey was returned with the code number and name removed (n = 2). With the noted exceptions, a total of 286 teacher surveys met the criteria for inclusion. Of these, 129 teachers returned the survey for a response rate of 45%. The response rate remained low despite four survey mailings and follow-up phone calls. Although the return rate does not approach the common standard of 70% and could be considered a limitation, it is acknowledged that 50% is a typical return rate for mail questionnaires (Weisberg, Krosnick, & Bowen, 1989). No statistically significant differences were found between respondents and nonrespondents for level of teaching (i.e., middle school and high school);(χ^2 = .945, p = .623), school size (χ^2 = 2.365, p = .306), and number of general and special education teachers (χ^2 = 3.745, p = .053). However, a significant difference was determined between school locales of respondents and nonrespondents (i.e., urban, suburban, and rural);(χ^2 = 8.786, p = .012), with a larger percentage of respondents represented in each category. Thus, in relation to these variables, respondents and nonrespondents were generally more similar than different.

TABLE 1
Comparison of the Number and Percentage of Schools by Locale and Student Enrollment for Maryland and the Survey Sample

Locale/Population	*No. (%) Maryland*	*Total Sample*
Urban		
0-599	83 (18)	52 (16)
600-999	143 (32)	68 (21)
1,000 and more	131 (29)	69 (21)
Total Urban	357 (79)	139 (58)
Suburban		
0-599	6 (1)	12 (4)
600-999	10 (2)	24 (7)
1,000 and more	4 (<1)	6 (2)
Total Suburban	20 (4)	42 (13)
Rural		
0-599	35 (8)	35 (11)
600-999	25 (6)	39 (12)
1,000 and more	16 (4)	20 (6)
Total Rural	76 (17)	94 (29)

School Selection. A stratified random sample of schools was selected across population density (i.e., urban, suburban, and rural), enrollment (i.e., 0-599, 600-999, 1,000 and greater), and school levels (i.e., middle school, and high school). Percentages of schools across population density and enrollment were established to maintain a sample consistent with the overall make-up of schools within Maryland (see Table 1). While the return rate resulted in minor differences in these percentages, surveys were distributed with the intention of approximating the general characteristics of the state. Additionally, an approximate equal number of surveys were distributed to both middle and high schools.

A total of 137 schools refused to participate and of these, 73.7% (n = 101) were from urban locales, 21.9% (n = 30) from rural locales, and 4.4% (n = 6) from suburban locales. In contrast, student population of the schools refusing to participate was more equally distributed. Approximately one-third of the 137 schools were in each population category, with 32.1% (n = 44) having up to 599 students, 32.8% (n = 45) with 600-999 students, and 35.0% (n = 48) with 1,000 or more students.

Data Analysis Procedures. Data analysis for the survey included descriptive statistics and additional statistical methods, such as t-tests or Analysis of Variance (ANOVA) to compare group means. Given the ordinal data and the fact that some of the variables were not normally distributed (i.e., kurtosis or skewness greater than 1.0), nonparametric statistics were also calculated, with the alpha level set at .01 to reduce possible Type II errors. These nonparametric statistics included chi-square tests to compare proportions, Mann-Whitney U tests to compare medians between groups, and nonhierarchical regression analyses to determine how well certain variables (e.g., age, level, and number of methods courses) predict teacher familiarity, confidence, and favorable student response. Results were reported for the second analyses whenever differences existed with parametric statistics.

RESULTS

DEMOGRAPHICS

Analysis of demographics included both teacher and student information. Approximately 45% of general education (n = 65) and special education

teachers (n = 64) responded for a total of 129 teachers. Forty-eight percent of these teachers (n = 62) were from urban school districts, followed by 36% rural (n = 46) and 16% suburban (n = 21) (see Table 1). Responses to demographic questions were further analyzed across teacher-type (special versus general education math teachers) (see Table 2). The majority of general education (n = 44) and special education (n = 51) teachers were female (69% and 80%, respectively).

Further, general education teachers taught for more years than the participating special educators (see Table 2). A significant difference was determined across general and special educators and years of experience teaching students with LD and ED. Compared to special educators, general education teachers had more years of experience teaching students with LD (χ^2 = 12.872, p = .025) and ED (χ^2 = 15.763, p = .008). Regarding the types of math courses currently being taught to students with LD and ED, teachers were asked to indicate "All that apply." The most commonly marked course for both general and special educators was middle school math for students with LD.

Teachers were questioned on pertinent student information, such as services provided and student achievement level. When asked the number of students with LD that were provided instruction in the general education math class with *no* special services provided, 29% of responding special education teachers (n = 10) indicated "None," and 40% of general education teachers (n = 10) indicated "1-5." The most common response to the range of students labeled ED with no special services was "1-5 ." Specifically, 71% of special educators (n = 25) and 48% of general education teachers (n = 29) noted this range. Further, when asked the number of students with LD that *were* receiving special services (e.g., consultative services, co-teaching) within general education math class, 43% of special educators (n = 15) noted "None." The second most frequent response to this question was "6-10 students" by 29% (n = 10) of special education teachers. Also, 33% of general education teachers (n = 20) indicated that no students were receiving additional special education services (e.g., resource support), followed by 25% of general education teachers (n = 15), indicating "1-5 students." In terms of students with ED receiving special services (e.g., consultative services and co-teaching) within general education math class, 63% of special educators (n = 22) noted "None." The second most frequent response to this question was "1-5 students" by 26% of special education teachers. Also, 48% of general education teachers (n = 29) indicated that no students were receiving additional special education services (e.g., resource support), followed by 37% of general education teachers (n = 22), indicating "1-5 students."

Researchers also analyzed general and special educator ratings of the achievement level common for students labeled LD and ED in math relative to peers without disabilities (1 = well above average, 2 = above average, 3 = about class average, 4 = below class average, 5 = well below class average, 6 = not applicable). Both groups of teachers reported the mean achievement level for students with LD more closely approached the performance of unlabeled students than did the achievement of students labeled ED. Further, special educators reported slightly higher achievement for students with LD (M = 3.85) versus general education teachers (M = 3.92). In contrast, general educators noted a higher-level of achievement for students with ED (M = 4.42), as compared to the responses of special educators (M = 4.73).

Methods Courses. Teachers also responded to questions concerning their prior methods courses that addressed, at least in part, teaching math to students with LD or ED. As reported in Table 3, a significant difference was found (χ^2 = 37.424, p = .000), with general education teachers indicating having taken more math methods courses. No significant differences were determined among special and general education teachers with regard to the number of special education math courses

A significant difference was determined across general and special educators and years of experience teaching students with LD and ED.

TABLE 2
Demographic Characteristics

Characteristics	*No. (%)*		*Significance*	
	Special Education Teachers	*General Education Teachers*	χ^2	p
Gender			3.516	.172
Female	51 (80)	44 (69)		
Male	12 (19)	20 (31)		
Age			4.085	.537
20-29	9 (14)	14 (22)		
30-39	19 (30)	14 (22)		
40-49	24 (38)	21 (33)		
50-59	12 (19)	13 (20)		
60 or >	0 (0)	1 (2)		
Educational Level			3.326	.068
BA	16 (25)	26 (41)		
MA	47 (75)	38 (60)		
Level of Teaching			.082	.960
High School	32 (50)	31 (48)		
Middle School	26 (41)	28 (43)		
Combination	6 (9)	6 (9)		
Years of Experience Teaching Math to Students with LD?			12.872	.025
<1	4 (6)	5 (8)		
1-5	24 (38)	25 (39)		
6-10	22 (35)	10 (15)		
11-15	2 (3)	6 (9)		
16-20	8 (13)	5 (8)		
21 or >	4 (6)	14 (22)		
Years of Experience Teaching Math to Students with ED?			15.76	3.008
<1	12 (20)	12 (19)		
1-5	21 (34)	23 (37)		
6-10	17 (28)	7 (11)		
11-15	3 (5)	7 (11)		
16-20	7 (12)	3 (5)		
21 or >	1 (2)	11 (18)		

taken for teaching math to students with LD or ED (see Table 3).

Also computed were teachers' perceptions of their preparation resulting from math and special education methods courses, which focused on teaching math to students with disabilities. Following special education methods courses, a statistically significant difference was determined across teachers' perceptions ($t = 1.982$, $p = .050$), with special education teachers ($M = 2.44$) noting greater preparation than general education teachers ($M = 3.76$);(see Table 4). In addition, special education teachers ($M = 2.13$) noted significantly greater preparation ($t = 3.222$, $p = .002$) as a result of taking math education content methods

TABLE 3
Nature of Methods Courses

Survey Item	*No* (%)					Significance	
	None	*1-2*	*3-4*	*5-6*	*7or >*	χ^2	p
How many math methods courses have you taken?						37.424	.000
Special Education Teachers	18 (29)	31 (50)	12 (19)	0	1 (2)		
General Education Teachers	1 (2)	19 (31)	24 (39)	7 (11)	11 (18)		
Number of special education methods courses taken that addressed, at least in part, teaching math to students with LD?						6.490	.167
Special Education Teachers	9 (15)	42 (68)	8 (13)	2 (3)	1 (2)		
General Education Teachers	20 (32)	32 (51)	6 (10)	4 (6)	1 (2)		
Number of special education methods courses taken that addressed, at least in part, teaching math to students with ED?						3.030	.391
Special Education Teachers	25 (42)	31 (52)	3 (5)	1 (2)	0		
General Education Teachers	36 (58)	24 (38)	2 (3)	1 (2)	0		

courses versus general education teachers (M = 3.76).

Teacher Familiarity, Confidence, and Student Response

Respondents were queried on whether they knew about the goals of the NCTM Standards. Ninety-five percent (n = 62) of general education teachers responded "Yes," versus 55% (n = 35) of special educators. Participants who answered "No" (i.e., never heard of the NCTM Standards) were deleted from analysis in questions pertaining to the implementation of and barriers to the implementation of the Standards. In closer analysis, respondents who had never heard of the NCTM Standards (n = 31) were mostly high school special education teachers from rural school districts (n = 8). The three general education teachers that had not heard of the NCTM Standards taught middle school from mostly urban school districts.

Mean ratings of teacher familiarity with the Standards (see Table 5) across general and special education teachers were nonsignificant using parametric statistics. General education teachers noted greater familiarity as compared to special education teachers. Specifically, 73% (n = 44) of general education teachers responded either "Strongly Agree" or "Agree" regarding familiarity with the goals of the Standards, versus 50% (n = 17) of special education teachers. However, results from a more sensitive measure, Mann-Whitney U test, revealed significant differences in teacher familiarity of the Standards across general and special education teachers (p = .002).

General and special education teachers were asked to rate their perceived level of confidence implementing the goals of the NCTM Standards with students labeled LD and ED (see Table 5).

Perceptions of favorable student response toward activities, lessons, and strategies that incorporate the recommendations of the Standards were determined to be nonsignificant across general and special education teachers.

TABLE 4

Nature of Methods Courses

	Mean Rating of Methods Courses on a 5-Point Scale[a]		*Significance*	
Survey Questions	*General Education Teachers*	*Special Education Teachers*	*t*	p
What is true regarding your prior math education content area courses that focused on teaching math?	3.04	2.13	3.222	.002
What is true regarding your prior special education courses that focused on teaching math?	3.76	2.44	1.982	.050

[a]1 = very prepared; 2 = somewhat prepared; 3 = no opinion; 4 = somewhat unprepared; 5 = very unprepared.

There was a significant difference across teachers ($t = 2.950$, $p = .004$), with general education teachers reporting greater confidence. For instance, 78% ($n = 47$) of general education teachers marked "Strongly Agree" or "Agree" versus 59% ($n = 20$) of special education teachers.

Perceptions of favorable student response toward activities, lessons, and strategies that incorporate the recommendations of the Standards were determined to be nonsignificant across general and special education teachers. Fifty-five percent ($n = 32$) of general and 58% ($n = 19$) of special educators rated, "Strongly Agree" or "Agree" that student response was favorable, versus only 10% ($n = 6$) of general educators and 6% ($n = 2$) of special education teachers who rated "Disagree" or "Strongly Disagree."

Barriers

Special educators were queried regarding the extent to which a lack of support from the general educators was a barrier. Seventy-one percent ($n = 25$) of the respondents answered "Sometimes" and "Rarely," and the mean was 3.61. For general education teachers, the issue of support from special educators was less pronounced, with a mean score of 3.8 ($n = 58$). Specifically, 60% ($n = 39$) of general educators noted that this issue was "Rarely" or "Never" a barrier, and an additional 15.4% ($n = 10$) responded "Somewhat."

Analysis of perceived barriers to implementation of the NCTM Standards was conducted across two general grade level categories (i.e., middle school and high school) and across special and general educators (see Table 6). When comparing the views of teachers concerning barriers across middle and high school, no significant differences were observed. However, it is interesting to note that, on average, both groups identified a lack of administrative support as the barrier least affecting successful implementation. In contrast, a lack of materials was considered the greatest barrier.

Significant differences do exist ($t = 2.17$, $p = .033$) between the overall means for special and general educator responses on the extent to which they view a lack of administrative support as a barrier toward successful implementation of the Standards. However, use of the Mann-Whit-

A primary concern is that many special education teachers indicated they were unfamiliar with the goals of the NCTM Standards.

TABLE 5
Teacher Familiarity, Confidence, and Student Response

	Mean Rating on 5-Point Scale[a]		*Significance*	
Teacher Perceptions	*General Education*	*Special Education*	*t*	P
I feel familiar with the goals of the NCTM Standards for teaching mathematics.	2.15	2.88	1.470	.145
I feel confident in my ability to teach mathematics relative to the goals of the NCTM Standards.	1.97	2.59	2.950	.004
My students with special needs respond favorably when I work on activities/lessons that apply these goals.	2.57	2.82	1.599	.113

[a]1 = strongly agree; 2 = agree; 3 = undecided; 4 = disagree; 5 = strongly disagree.

ney U test did not show significant differences across teachers (p = .372). General education teachers reported this issue was more frequently a barrier than their special education counterparts. Despite this significant difference, 66.6% of general educators (n = 38) and 78.2% of special educators (n = 25) reported administrative support was "Rarely" or "Never" an issue.

Important information on teacher perceptions of barriers is also available through an evaluation of the group means. For example, on average both general and special educators indicated that a lack of materials was a relatively frequent barrier (see Table 6). Approximately 76% (n = 44) of general educators and 88% (n = 29) of special educators responded that this issue is a barrier "Always," "Frequently," or "Sometimes." In contrast, the district curriculum was less often seen as a barrier, with group means of 3.98 and 3.48 for general and special educators, respectively. Specifically, 80.7% (n = 45) of the general education teachers and 51.6% (n = 16) of special educator respondents noted the occurrence of the issue "Rarely" or "Never." While a lower percentage of special educators responded "Rarely" or "Never," an additional 35.5% (n = 11) of these teachers commented that the district curriculum was a barrier "Sometimes."

Factors Affecting Teacher Response

First, a correlation table was constructed to determine variables that were significantly correlated with one another. Results of the correlational analysis between the criterion variables (i.e., teacher confidence, favorable student response, and familiarity) and predictor variables (i.e., age, level, teacher type, school population, locale, years of teaching, highest degree earned, student achievement, number of methods courses, gender, course preparation, familiarity with the Standards, confidence implementing the Standards, or favorable student response) included moderate to strong correlations. To further examine the relationships across variables, a series of one-way analyses of variance were conducted across dependent variables (i.e., familiarity, confidence, and favorable student response) and predictor variables. No significant differences were determined among these variables. Finally, nonparametric statistics were used to determine the contribution of the predictor variables on various criteria (i.e., teacher confidence, favorable student response, and familiarity).

Teacher Confidence. Teacher confidence in their ability to teach math relative to the goals of their NCTM Standards was strongly correlated with familiarity of the goals (r = .74). The authors

TABLE 6

Effect Barrier Has on NCTM Standards Implementation

	Mean Rating of Barrier on 5-Point Scale[a]		*Significance*	
Barrier	*General Education Teachers*	*Special Education Teachers*	*t*	p
Lack of materials	2.98	2.58	1.06	.290
District's curriculum	3.98	3.48	1.74	.085
Current textbook	3.38	2.97	.17	.863
Lack of administrative support	3.77	4.03	2.17	.033
Lack of information/knowledge	3.64	3.41	.48	.630

[a]1= always; 2 = frequently; 3 = sometimes; 4 = rarely; 5 = never.

used nonhierarchical regression analysis to determine the contribution of 10 variables (i.e., years of teaching ED, years of teaching LD, number of methods courses, preparation, teacher type, familiarity, favorable student response, achievement, lack of administrative support, and lack of information) to predict the level of teacher confidence when teaching math activities that reflect the goals of the NCTM Standards. The total contribution of these variables was determined for an "overall" predictor variable contribution to teacher confidence. This accounted for 61% of the variance for overall teacher confidence.

To determine the contribution of each, variables were entered into the first position of the linear equation. Then, each variable was entered in the last position to determine if the variable significantly contributed to teacher confidence beyond the contribution of the other variables. As shown in Table 7, when entered in the first position, the *t*-test for Beta weights was statistically significant for six variables (i.e., teacher familiarity, favorable student response, number of methods courses, lack of information, years of teaching ED, and teacher type), thus contributing to teacher confidence. However, the *t*-test for Beta weights was significant for only two variables (i.e., familiarity and years of teaching ED), when entered in the final position of the linear equation. It was determined that familiarity accounted for 10% of the variance and years of teaching ED 3% beyond the contribution of the other variables.

Teacher Familiarity. Lack of information/knowledge as a barrier affecting successful Standards implementation had a strong-to-moderate negative correlation with familiarity of the Standards (r = -.67) and confidence level (r = -.46). Thus, teachers who indicated that a lack of information was a barrier to successful Standards implementation were generally unfamiliar with the Standards and did not feel confident implementing the Standards.

A nonhierarchical regression analysis was also used to determine the contribution of seven variables (i.e., years of teaching ED, years of teaching LD, number of methods courses, preparation, confidence, teacher type, and favorable student response) to predict the level of teacher familiarity with the goals of the NCTM standards. Sixty percent of the variance for overall teacher familiarity with the Standards was determined with the noted variables entered into the

Although there are a number of effective resources for teachers, one consideration should be the use of materials that have been empirically validated.

TABLE 7
Non-Hierarchical Regression Analysis for Teacher Perception of Confidence

	Initial Entry of the Construct			*Construct Entered in Last Position*	
Variables	*Simple R*	*R Squared*	p-*value*	*R Squared Increment*	p-*value*
Years Teaching ED	.350	.130	.001	.030	.044
Years Teaching LD	.140	.019	.185	.016	.126
Number of Methods Courses	.480	.231	.000	.038	.148
Preparation	.140	.018	.438	.009	.522
Teacher Type	.330	.107	.001	.004	.437
Familiarity	.740	.551	.000	.100	.000
Student Response	.570	.322	.000	.015	.014
Achievement	.230	.053	.106	.014	.358
Lack of Administrative Support	.111	.012	.314	.005	.414
Lack of Information	.460	.213	.000	.000	.924

regression equation. As shown in Table 8, the *t*-test for Beta weights was statistically significant for five variables (i.e., confidence, favorable student response, number of methods courses, teacher type, and years teaching ED) when each was entered in the first position. The *t*-test for Beta weights was significant for two variables (i.e., confidence and favorable student response), when entered in the final position. Teacher confidence accounted for 18% of the variance, and favorable student response accounted for 2% of the variance beyond the contribution of the other variables.

Favorable Student Response. Teacher perceptions of favorable student response to activities that incorporate the goals of the Standards were moderately correlated with teacher familiarity of the goals of the Standards ($r = .54$) and teacher confidence in their ability to teach math relative to the goals of the Standards ($r = .57$). Results of the nonhierarchical regression analysis showed that 41% of the variance for overall favorable student response was determined with the noted variables entered into the regression equation. When entered in the first position, the *t*-test for Beta weights was statistically significant for four variables (i.e., confidence, familiarity, years teaching ED, and preparation);(see Table 9). The *t*-test for Beta weights was significant for two variables (i.e., confidence and familiarity) when entered in the final position of the linear equation. It was determined that confidence accounted for 4% of the variance and familiarity 4% beyond the contribution of the other variables.

DISCUSSION

The results of this study indicate that, according to general and special educator perceptions, several issues must be considered for successful implementation of activities based on the goals of the NCTM Standards. Specifically, five central themes come to light: (a) teacher unfamiliarity with the Standards, (b) variables that affect teacher confidence in implementing Standards-based activities, (c) favorable student response to Standards-based activities, (d) significant barriers (i.e., lack of materials) to successful implementa-

TABLE 8
Non-Hierarchical Regression Analysis for Teacher Perception of Familiarity

	Initial Entry of the Construct			*Construct Entered in Last Position*	
Variables	*Simple R*	*R Squared*	p-*value*	*R Squared Increment*	p-*value*
Years Teaching ED	.31	.094	.004	.000	.865
Years Teaching LD	.12	.015	.232	.000	.985
Number of Methods Courses	.44	.191	.002	.003	.921
Preparation	.09	.009	.674	.012	.342
Confidence	.74	.551	.000	.183	.000
Teacher Type	.31	.093	.003	.006	.308
Student Response	.54	.295	.000	.022	.054

tion of Standards-based activities, and (e) level of math courses typically taught by teachers of students with LD and ED.

A primary concern is that many special education teachers indicated they were unfamiliar with the goals of the NCTM Standards. This is of concern given that the Standards were first published in 1989 and were also revised in April 2000. Further, as more students with LD and ED are educated in general education math classes, special education teachers need greater familiarity with the Standards to accommodate and adapt to individual learning needs.

For teachers who are familiar with the Standards, certain variables influenced teacher confidence with the Standards. Specifically, teacher confidence was influenced by familiarity, student response, number of methods courses, a lack of information, years of teaching ED, and teacher type. The overall contribution of all variables accounted for 61% of the variance. Two of these variables were uniquely and significantly related to teacher confidence (familiarity and years of teaching ED), when all other variables were controlled. Thus, teacher confidence in the ability to teach math consistent with goals of the Standards, significantly relates to familiarity with the Standards. However, it should be noted that this relationship does not necessarily imply actual teacher implementation of activities consistent with the NCTM Standards. As Batchelder (1998) determined, " . . . teachers may be familiar with the language of standards-based strategies, but not understand the implications of these strategies for teaching and learning" (p. 12). To identify the link between teacher confidence, familiarity with the Standards, and classroom practices, future research should include the addition of observation to validate teacher perceptions.

Researchers also determined that more than half of general and special educators indicated students responded favorably to activities, lessons, and strategies that incorporate the recommendation of the Standards. This is consistent with past research on students' views of mathematics when taught in classes that are in line with Standards-

The lack of suitable materials is especially disconcerting for students with LD and ED who require manipulatives, multiple representations, and varied examples and nonexamples as teachers progress through the concrete-semi-concrete-abstract phases of instruction that are recommended.

TABLE 9

Non-Hierarchical Regression Analysis for Teacher Perception of Student Response

	Initial Entry of the Construct			*Construct Entered in Last Position*	
Variables	*Simple R*	*R Squared*	p-*value*	*R Squared Increment*	p-*value*
Years Teaching ED	.28	.080	.008	.005	.437
Years Teaching LD	.13	.017	.215	.001	.716
Number of Methods Courses	.27	.065	.137	.004	.925
Preparation	.26	.070	.045	.027	.209
Confidence	.57	.322	.000	.038	.039
Teacher Type	.10	.010	.338	.000	.853
Level of Teaching	.00	.000	.994	.010	.284
Familiarity	.54	.295	.000	.035	.047

based reform efforts. Specifically, Brown, Kreisman, & Noble (1999) determined that students had a more positive view of math, stated greater confidence in the ability to be successful in math, and wanted to learn more about math. However, as Brown et al. caution, "It is important to keep in mind that although students may have more positive attitudes toward mathematics, this does not automatically indicate they will have increased achievement" (p. 19). In fact, recent research (Papanastasiou, 2000) from the TIMSS indicates no significant relationship between student attitude and achievement. Thus, conclusions based on teacher perception of student favorable response should be made with caution.

Four variables (i.e., confidence, familiarity, years of teaching ED, and preparation) significantly related to favorable student response. Further, two variables (confidence and familiarity) uniquely and significantly contributed to this criterion variable when all other variables were controlled. Relatedly, Meyen, Vergason, and Whelan (1993) noted that a positive attitude toward teaching math and enthusiasm toward the subject matter positively impacts student attitudes. However, this link between teacher confidence, familiarity with the Standards, and favorable student response requires further study.

In addition, barriers exist that impede successful implementation of the Standards by special and general educators when instructing students with LD and ED. Teachers identified administrative support and district curricula as relatively minor issues. This indicates that within the district and school levels, there is a general acceptance and adherence to the NCTM Standards. However, teachers did note that a lack of adequate materials was a considerable barrier to successful implementation of activities based on the Standards. The issue of inadequate materials has also been noted in the literature as hindering other teacher practices. For instance, in their analysis of 28 surveys on general education teachers' attitudes toward inclusion, Scruggs and Mastropieri (1996) determined that only one-third of teachers felt they had resources to adequately address student needs. The lack of suitable materials is especially disconcerting for students with LD and ED who require manipulatives, multiple representations, and varied examples and nonexamples as teachers progress through the concrete-semi-concrete-abstract phases of instruction that are recommended (Maccini & Gagnon, 2000). Further, the highly conceptual and problem-solving approach that is recommended by

NCTM contributes to the importance of adequate materials.

Having students with LD and ED learn to solve complex, real-world math problems can promote generalization to other real world tasks, application of skills across time (Bottge & Hasselbring, 1993), and conceptual understanding of mathematics (Van De Walle, 1994). This is imperative given that the Individuals with Disabilities Education Act (IDEA, 1997) calls for all students to have access to the general education curriculum to the greatest extent possible and accountability for learning the same material as their peers without disabilities. However, in the current study, respondents generally reported teaching lower-level math courses to secondary students with LD and ED (e.g., basic skills math, middle school math), versus higher-level math courses. This may have detrimental effects for students with LD and ED as the lack of challenging math content may hinder student achievement and possibly limit future career choices in mathematics. Additional research is necessary to identify the extent to which students with LD and ED have access to higher level math courses with appropriate academic supports.

Limitations and Future Research

Although important results emanated from the current study, caution must be made when generalizing results beyond Maryland. Future studies should include a national sample of general and special education teachers' perceptions related to implementation of the Standards with secondary students with LD and ED. In addition to modifications in sampling procedures, future studies should also include different research methods to determine teachers' perspectives and behaviors. One such method is triangulation, which combines quantitative and qualitative research methods to investigate the variables of interest (Campbell & Fiske, 1959). These methods represent different roles in data interpretation that will be essential to the integration of information involving various perspectives and behaviors (Sieber, 1973). For example, as "lack of materials" was targeted as a common barrier, teachers should be interviewed and observed regarding the types and uses of materials perceived as necessary for effective implementation of activities based on the Standards. Recommendations for future courses of action can then be delineated.

IMPLICATIONS FOR PRACTICE

Important implications for both general and special education teachers based on the current research include the need to educate and support teachers in their efforts to teach mathematics to students with LD and ED in light of the goals of the NCTM Standards. Such supports include:

Training and dissemination

Given that 55% of special educators indicated they had not heard of the Standards, intensive teacher training via workshops and inservices are needed. This issue is particularly critical for high school special education teachers in rural areas. It is from this locale that the largest percentage of respondents (28%, $n = 8$) had not heard of the Standards. Thus, it is imperative that schools train special education teachers on the revised Standards (NCTM, 2000) and approaches to meeting the needs of students with disabilities in general education classes. Additionally, information provided in teacher training programs is vital to help educate teachers on the latest reform efforts.

Adequate Resources. Special and general educators both indicated the lack of materials as a barrier to successful Standards implementation. Teachers have consistently cited inadequate materials as a barrier to successful implementation of educational reform (Scruggs & Mastropieri, 1996). However, the availability of resources does not "reveal how these resources are used" or by whom. And they say nothing about the quality of that use (McLaughlin et al., 1995, p. 46). Notwithstanding, adequate materials are one essential component to successful implementation of activities based on the Standards.

Teachers in the current study did not identify which materials were lacking. However, adequate manipulatives are essential for students with LD and ED when completing higher-level math tasks. Although there are a number of effective resources for teachers, one consideration should be the use of materials that have been empirically validated. For example, the Algebra Lab Gear (colored blocks that represent numeric and vari-

able amounts; Picciotto, 1990) is one validated tool teachers may use to help students visualize a problem and follow logical steps during activities focusing on algebraic reasoning. This representation is supported within the goals of the Standards (NCTM, 2000). Additionally, students and teachers could benefit from varied texts and resources that present math activities embedded in real-world problems. For example, the Connected Math Series (Lappan, Fey, Fitzgerald, Friel, & Phillips, 1998), which has an orientation and organization consistent with the NCTM Standards, can be used as a supplement to traditional texts (Reys et al., 1998).

One creative approach to a lack of materials is currently being implemented within some secondary schools in Maryland. Students are allowed to borrow or "rent-to-own" graphing calculators that have been procured through donations or agreements with local companies. This approach assures that students have equal access to current technology and can participate fully in math activities within and outside of school.

Higher-level Mathematics. In the current study, the most prevalent courses taught by respondents involved general/basic skills mathematics, versus higher-level math, such as algebra and geometry. Approximately an equal number of middle and high school teachers responded to the survey. It could be assumed that middle school math would typically be taught by middle school teachers. However, it is becoming more common for nonlabeled students to take algebra in the seventh or eighth grades and one would certainly expect a majority of students with LD and ED to be enrolled in algebra by the high school level. As IDEA assures students with disabilities have access to the general education curriculum, it is important to consider whether these students are enrolled in higher-level math courses with appropriate academic supports. Thus, there is a need for future research to examine the placement of students with LD and ED in math classes and whether these students would be successful in higher-level mathematics with supports that have been empirically validated. For example, manipulatives (Huntington, 1994; Maccini, & Hughes, 2000) and cognitive strategy instruction (Hutchinson, 1993) have been determined to help students with mild disabilities in higher-level mathematics. Future research on combinations of these supports within the context of higher-level mathematics courses is crucial to assist students in meeting district and state requirements for graduation and for future occupations.

To assure positive academic outcomes, students with LD and ED must have access to the general education curriculum and rigorous standards, such as those set forth by NCTM. However, to meet the unique needs of these students, and better prepare students for their "next environment," it is imperative that teachers are given adequate supports, training, and resources. As stated by the National Research Council (2001), "For people to participate fully in society, they must know basic mathematics. Citizens who cannot reason mathematically are cut off from whole realms of human endeavor" (p. 1). This can be realized with knowledgeable and empowered teachers who are provided the necessary tools and information to implement math instruction consistent with the most recent reform movements and empirically validated instructional approaches.

REFERENCES

Anderson, J. A., Kutash, K., & Duchnowski, A. J. (2001). A comparison of the academic progress of students with ED and students with LD. *Journal of Emotional and Behavioral Disorders, 9,* 106-115.

Baroody, A. J., & Hume, J. (1991). Meaningful mathematics instruction: The case for fractions. *Remedial and Special Education, 12,* 54-68.

Batchelder, M. L. (1998). *Austin collaborative for mathematics education.* Austin, TX: Austin Independent School District. (ERIC Document Reproduction Service No. ED 428 103)

Blank, R., & Dalkilic, M. (1992). *State policies on science and mathematics education.* Washington, DC: State Education Assessment Center, Council of Chief State School Officers. (ERIC Document Reproduction Service No. ED 350 163)

Blankenship, C. S., & Lovitt, T. C. (1976). Story problems: Merely confusing or downright befuddling? *Journal for Research in Mathematics Education, 7,* 290-298.

Bos, C. S., & Vaughn, S. (1994). *Strategies for teaching students with learning and behavior problems* (3rd ed., pp. 311-342). Boston, MA: Allyn and Bacon.*

Bottge, B., & Hasselbring, T. S. (1993). A comparison of two approaches for teaching complex, authentic mathematics problems to adolescents in remedial math classes. *Exceptional Children, 59,* 556-566.

Bricklin, P. M., & Gallico, R. (1984). Learning disabilities and emotional disturbance: Critical issues in definition, assessment, and service delivery. *Learning Disabilities, 3,* 141-156.

Brown, P. J., Kreisman, M. B., & Noble, A. J. (1999). *What students have to say about mathematics: Education reform and students' reality.* Paper presented at the annual meeting of the American Educational Research Association, Montreal, Canada. (ERIC Document Reproduction Service No. ED 443 727)

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validity by the multi-trait, multimethod matrix. *Psychological Bulletin,* 56, 81-105.

Carr, S., & Punzo, R. P. (1993). The effects of self-monitoring of academic accuracy and productivity on the performance of students with behavioral disorders. *Behavioral Disorders, 18,* 241-250.

Cawley, J. F., & Miller, J. H. (1989). Cross-sectional comparisons of the mathematics performance of children with learning disabilities: Are we on the right track towards comprehensive programming? *Journal of Learning Disabilities, 22,* 250-254.

Fink, A. (1995). *The survey handbook.* (Vol. 1). Thousand Oaks, CA: Sage.*

Fowler, F. J., Jr. (1988). *Survey research methods.* Newbury Park, CA: Sage.*

Gagnon, J. C., McLaughlin, M. J., Rhim, L. M., & Davis, G. A. (in press). Standards-driven reform at the local level: Report on a survey of local special education directors in large districts. *Journal of Special Education Leadership.*

Gallico, R., Burns, T. J., & Grob, S. C. (1991). *Emotional and behavioral problems in children with learning disabilities.* San Diego, CA: Singular.*

Goals 2000: Educate America Act (1994). P.L. No. 103-227, 103rd Congress.

Guntner, P. L., & Denny, R. K. (1998). Trends and issues in research regarding academic instruction of students with emotional and behavioral disorders. *Behavioral Disorders, 24,* 44-50.

Hogan, S., & Prater, M. A. (1993). The effects of peer tutoring and self-management training on on-task, academic, and disruptive behaviors. *Behavioral Disorders, 18,* 118-128.

Huntington, D. J. (1994). Instruction in concrete, semi-concrete, and abstract representation as an aid to the solution of relational problems by adolescents with learning problems. (Doctoral dissertation, University of Georgia, 1994). *Dissertation Abstracts International, 56/02,* 512.

Hutchinson, N. L. (1993). Effects of cognitive strategy instruction on algebra problem solving of adolescents with learning disabilities. *Learning Disability Quarterly, 16,* 34-63.

Improving America's Schools Act (1994). P.L. No. 103-328, 103rd Congress.

Individuals with Disabilities Education Act (IDEA) of 1997, P L. No. 105-17. U.S. Department of Education, Washington, DC. (ERIC Document Reproduction Service No. ED 430 325)

Kauffman, J. M. (2001). *Characteristics of emotional and behavioral disorders of children and youth* (7th ed.). Upper Saddle River, NJ: Simon & Schuster.

Lappan, L. G., Fey, J. F., Fitzgerald, W. M., Friel, S. N., & Phillips, E. D. (1998). *Connected mathematics.* Menlo Park, CA: Dale Seymour Publications.*

Maccini, P., & Gagnon, J. C. (2000). Best practices for teaching mathematics to secondary students with special needs: Implications from teacher perceptions and a review of the literature. *Focus on Exceptional Children, 32*(5), 1-22.

Maccini, P., & Hughes, C. A. (2000). Mathematics interventions for adolescents with learning disabilities. *Learning Disabilities Research & Practice, 15,* 10-21.

Manouchehri, A. (1998). Mathematics curriculum reform and teachers: What are the dilemmas? *Journal of Teacher Education, 49,* 276-285.

Marolda, M. R., & Davidson, P. S. (1994). Assessing mathematical abilities and learning approaches. In C. A. Thornton & N. S. Bley (Eds.), *Windows of opportunity: Mathematics for students with special needs* (pp. 61-82). Reston, VA: National Council of Teachers of Mathematics. (ERIC Document Reproduction Service No. ED 404 115)

Maryland State Department of Education (2000, August). *High School Assessments* (Fact Sheet 1). Baltimore, MD: Author.

McDonnell, L. M., McLaughlin, M. J., & Morison, P. (Eds.) (1997). *Educating one & all: Students with disabilities and standards-based reform.* Washington, DC: National Academy Press.

McLaughlin, M. J. (1999). Access to the general education curriculum: Paperwork and procedure or redefining special education. *Journal of Special Education Leadership, 12*(1), 9-14.

McLaughlin, M. W., Shepard, L. A., & O'Day, J. A. (1995). *Improving education through standards-based reform.* Stanford, CA: The National Academy of Educa-

tion. (ERIC Document Reproduction Service No. ED 387 867)

McLeod, T. M., & Armstrong, S. W. (1982). Learning disabilities in mathematics skill deficits and remedial approaches at the intermediate and secondary level. *Learning Disability Quarterly, 5,* 305-311.

Meyen, E. L., Vergason, G. A., & Whelan R. J. (1993). *Educating students with mild disabilities.* Denver, CO: Love Publishing.*

Montague, M., & Bos, C. S. (1990). Cognitive and metacognitive characteristics of eighth grade students' mathematical problem solving. *Learning and Individual Differences, 2,* 371-388.

Montague, M., Bos, C., & Ducette, M. (1991). Affective, cognitive, and metacognitive attributes of eighth-grade mathematical problem solvers. *Learning Disabilities Research & Practice, 6,* 145-151.

National Center for Education Statistics (1995). *Common core of data (CCD): School years 1991-1992 through 1995-1996.* Arlington, VA: Sierra Systems Consultants, Inc.

National Council of Teachers of Mathematics (NCTM). (1989). *Curriculum and evaluation standards for school mathematics.* Reston, VA: Author. (ERIC Document Reproduction Service No. ED 344 778)

National Council of Teachers of Mathematics (NCTM). (1991). *Professional standards for teaching mathematics.* Reston, VA: Author.

National Council of Teachers of Mathematics (NCTM). (1995). *Assessment standards for school mathematics.* Reston, VA: Author. (ERIC Document Reproduction Service No. ED 388 516)

National Council of Teachers of Mathematics (NCTM). (2000). *Principles and Standards for School Mathematics.* Reston, VA: Author.

National Institute on Educational Governance, Finance, Policymaking, and Management (1998). *What the Third International Mathematics and Science Study (TIMSS) means for systematic school improvement* (Policy Brief). Washington, DC: Author. (ERIC Document Reproduction Service No. ED 425 938)

National Research Council (2001). *Adding it up: Helping children learn mathematics.* Washington, DC: National Academy Press.

Nolet, V., & McLaughlin, M. J. (2000). *Accessing the general curriculum: Including students with disabilities in standards-based reform.* Thousand Oaks, CA: Corwin Press.*

Papanastasiou, C. (2000). Effects of attitudes and beliefs on mathematics achievement. *Studies in Educational Evaluation, 26,* 27-42.

Parmer, R. S., & Cawley, J. F. (1995). Mathematics curricula framework: Goals for general and special education. *Focus on Learning Problems in Mathematics, 17,* 50-66.

Picciotto, H. (1990). *The algebra lab.* Sunnyvale, CA: Creative Publications.*

Reys, R., Reys, B., Barnes, D., Beem, J., & Papick, I. (1998). What is standing in the way of middle school mathematics curriculum reform? *Middle School Journal, 30,* 42-48.

Rivera, D. P., Taylor, R. L., & Bryant, B. R. (1994/1995). Review of current trends in mathematics assessment for students with mild disabilities. *Diagnostique, 20,* 143-174.

Salend, S. J., & Hofstetter, E. (1996). Adapting a problem-solving approach to teaching mathematics to students with mild disabilities. *Intervention in School and Clinic, 31,* 209-217.

Sands, D. J., Adams, L., & Stout, D. M. (1995). A statewide exploration of the nature and use of curriculum in special education. *Exceptional Children, 62,* 68-83.

Scruggs, T. E., & Mastropieri, M. A. (1986). Academic characteristics of behaviorally disordered and learning disabled students. *Behavioral Disorders, 11,* 184-190.

Scruggs, T. E., & Mastropieri, M. A. (1996). Teacher perceptions of mainstreaming/inclusion, 1958-1995: A research synthesis. *Exceptional Children, 63,* 59-74.

Shriner, J. G., Kim, D., Thurlow, M. L., & Ysseldyke, J. E. (1993). *IEP's and standards: What they say for students with disabilities* (Tech. Rep. No. 5). Minneapolis, MN: National Center on Educational Outcomes. (ERIC Document Reproduction Service No. ED 358 659)

Sieber, S. D. (1973). The integration of fieldwork and survey methods. *American Journal of Sociology,* 78, 1335-1359.

Smith, S. W. (1990). Individualized education programs (IEP's) in special education: From intent to acquiescence. *Exceptional Children, 57,* 6-14.

Thurlow, M. L. (2000). Standards-based reform and students with disabilities: Reflections on a decade of change. *Focus on Exceptional Children, 33*(3), 1-15.

U.S. Department of Education (2000). *Twenty-second annual report to Congress on the implementation of the Individuals with Disabilities Education Act.* Washington, DC: Author. (ERIC Document Reproduction Service No. ED 444 333)

Van De Walle, J. (1994). *Elementary school mathematics* (2nd ed.). New York: Longman.*

Wagner, M. (1995). Outcomes for youth with serious emotional disturbance in secondary school and early adulthood. *Future of Children, 5*(2), 90-113.

Weisberg, H. F., Krosnick, J. A., & Bowen, B. D. (1989). *An introduction to survey research and data analysis* (2nd ed.). Glenview, IL: Scott, Foresman and Company.

Yin, R. K. (1994). *Case study research: Design and methods.* Thousand Oaks, CA: Sage.*

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