National Survey on Supporting Struggling Mathematics Learners in the Middle Grades

METHODOLOGY

The *National Survey on Supporting Struggling Mathematics Learners in the Middle Grades* was one component of our *Strengthening Mathematics Intervention* project, funded by the National Science Foundation. The purpose of this nationally representative survey was to estimate the percentage of schools providing mathematics intervention (MI) classes in the middle grades (that is, grades 6, 7 and 8) and to gather information about the landscape of those MI classes. For this study, MI classes are defined as classes taken by struggling students during the regular school day in addition to their general education mathematics classes. These classes focus only on mathematics content, in contrast to support classes, which include multiple subject areas. MI classes are for students who struggle with mathematics, including learners who do *not* have identified disabilities and those with Individualized Education Programs. (They are *not* separate special education mathematics classes.)

This study aimed to address the following questions:

(1) What percent of U.S. public schools with grades 6–8 have MI classes for struggling learners?
(2) What are the current structures, practices, and challenges of MI classes?

This supplementary document describes the development of the survey instrument, the population and sample, and the administration of the survey. It also includes a description of the methodology used to analyze the survey data, focusing on the results presented in the Executive Summary. The Executive Summary, survey instrument, and supporting data tables are available at edc.org/accessmath.

SURVEY DEVELOPMENT, SAMPLE SELECTION, AND SURVEY ADMINISTRATION

This section describes the process for developing the survey, the selection of a nationally representative sample, and how the survey was administered.

SURVEY DEVELOPMENT

To inform the development of the national survey, we examined pertinent research, such as the *IES Practice Guide: Assisting Students Struggling with Mathematics* (Gersten et al., 2009), reports by the National Center on Response to Intervention (RtI; n.d.ab)) on RtI in middle schools and Swanson, Solis, Ciullo, and McKenna's (2012) observational study of intervention classes. Because there were no published surveys specifically on MI classes in the middle grades, we reviewed relevant instruments to identify pertinent topics and questions to include

in our survey. These tools include the *District Algebra Supports Study Survey* (Mark, Louie, & Fries, 2012), *National Survey of Science and Math Education* (Baniflower et al., 2013), and the National Assessment of Educational Progress' (2017) *Mathematics Teacher Questionnaire—Grade 8*.

In addition to reviewing research and existing instruments, we drew on findings from our observational study, another component of the *Strengthening Mathematics Intervention* project, to identify topics for the survey and draft survey items. As part of the observational study, we identified a sample of 27 middle-grades MI teachers in Massachusetts and observed 54 MI classes (two per teacher) by taking running field notes with time stamps and then using the Reform Teaching Observation Protocol (RTOP)[1] and two project-developed instruments: *MI Class Observation Checklist of Instructional Practices* and a lesson-event table that captured the types of activities that occured during the lesson, along with the timing and grouping of students. Using a formal protocol, we conducted interviews with these MI teachers, with 25 school or district mathematics leaders in Massachusetts, and with 10 leaders from other states in all four U.S. Census regions (Midwest, Northeast, South, West). We coded their responses to the interview questions on their MI classes' strengths and challenges to identify common responses and produced descriptive statistics from the observation data to inform the development of survey items and to prioritize topics to be included in the national survey.

The survey's content validity was determined through content expert review and a pilot with the teachers in the observational study. The four reviewers brought expertise in mathematics education, special education, RtI, middle-grades education, and survey design as well as experience conducting their own surveys on relevant topics.

Teachers in the observational study completed the survey and also provided feedback on the clarity of the questions. We produced means and frequencies of the responses collected through the survey and used the findings to remove or revise survey items where the results were difficult to interpret. We compared participants' responses with multiple-choice and open-response questions on the same topic to identify inconsistencies that might indicate a need to clarify and revise a multiple-choice question. We also categorized the responses to open-ended questions to develop multiple-choice questions for the final national survey.

In the final stage, researchers conducted cognitive interviews with five educators representing all four U.S. Census regions to further test the survey's content validity and improve clarity and usability (Beatty & Willis, 2007).

The final national survey comprised 32 questions: 29 were closed-ended questions (multiple choice or Likert scale) and three were open-ended questions. The online survey had embedded logic to give an appropriate subset of questions to each respondent based on their answers to the questions about whether their school had MI classes during the 2016–17 school year and whether they taught an MI class that year. Respondents in schools that stated they had MI classes received 17 questions. If respondents were MI teachers, they received an additional 7

[1] The reliability estimates for each subscale of the RTOP ranged from 0.670 to 0.946, with an estimate of 0.954 for the total score (Piburn & Sawada, 2000). See https://eric.ed.gov/?id=ED447205.

questions (24 total). If the respondents' schools did *not* have MI classes, they received a total of 13 questions.

POPULATION

The sampling frame was based on the 2014–15 Common Core of Data (CCD) public-use files. All regular public schools in cities or suburbs were included that had students enrolled in grades 6, 7, and 8. The total number of eligible schools was 9,259. Schools were stratified by U.S. Census region to ensure representation from across the country and by percentage of students eligible for free or reduced-price lunch (FRPL). The two categories for the latter were schools with over 50% of students eligible for FRPL and schools with zero to 50% of students eligible for FRPL (Table 1).

Table 1: Population

Region	≤50% eligible for free or reduced-price lunch		>50% eligible for free or reduced-price lunch		Total	
	N	%	N	%	N	%
Midwest	890	10%	1,249	13%	2,139	23%
Northeast	1,030	11%	1,202	13%	2,232	24%
South	1,044	11%	1,787	19%	2,831	31%
West	843	9%	1,214	13%	2,057	22%
Total	3,807	41%	5,452	59%	9,259	100%

Data Sources: U.S. Department of Education, National Center for Education Statistics, Common Core of Data (CCD), 2014–15. Retrieved from https://nces.ed.gov/ccd/pubschuniv.asp.

SAMPLE

Because we wanted both to estimate the percent of schools providing MI classes in the middle grades and to provide information about the landscape of those MI classes, the sample of schools had to be large enough to estimate proportions for all schools and, separately, for the subset of schools that had MI classes. We estimated that 45% of eligible schools would have MI classes based on the 2015 National Assessment for Educational Progress survey data that indicated that 43% of public schools in cities and 42% of public schools in suburbs have mathematics resource teachers available for grade 8 students (U.S. Department of Education, 2015).

The minimum sample size (*n*) based on Yamane's (1967) formula for estimating proportions for the subset of schools that have MI classes was 365 schools, based on a desired confidence level of 95%, an assumption of the maximum amount of variation in the population of attributes to be observed (P=.5), a population of 4,167, and the desired level of precision of .05 (*e*). Under the conservative assumptions of a 40% response rate and 45% of schools having MI classes, we drew a sample of 2,028 schools. The schools were sampled from the strata proportional to the size of the target population.

We reviewed school websites and called schools to identify one staff person at each school to serve as the target respondent. The preferred target respondents were MI teachers, followed

by other contacts knowledgeable about mathematics instruction and support (e.g., mathematics specialists or teachers) at the schools. If we were unable to identify a mathematics contact, we asked the principal to forward the survey to an appropriate educator. While identifying target respondents, we learned that some schools closed or reorganized between the 2014–15 school year (the most recent year of CCD used to identify the sample) and the time of survey administration in spring 2017, making them ineligible to receive the survey. A school was ineligible if it was closed or combined with another school, or if it was a charter, virtual, or alternative school. We determined that 61 schools were ineligible under these criteria. Each ineligible school was replaced. There was one one replacement school for each school in the sample frame, randomly drawn from the population of schools that were in the same state and in the same decile nationally of students eligible for FRPL as the sample school.

Four schools that responded to the survey included information in their responses to the open-ended questions that indicated that they were ineligible (e.g., high school, alternative school). Thus, the sampling was revised to consist of 2,024 schools. Table 2 displays the sample, and Table 3 shows the base weights, which are equal to the population of schools in the strata divided by the number of sampled schools.

Table 2: Sample

Region	≤50% eligible for free or reduced-price lunch		>50% eligible for free or reduced-price lunch		Total	
	N	%	N	%	N	%
Midwest	194	10%	271	13%	465	23%
Northeast	226	11%	263	13%	489	24%
South	228	11%	391	19%	619	31%
West	184	9%	267	13%	451	22%
Total	832	41%	1,192	59%	2,024	100%

Data Source: U.S. Department of Education, National Center for Education Statistics, Common Core of Data (CCD), 2014–15. Retrieved from https://nces.ed.gov/ccd/pubschuniv.asp

Table 3. Base Sampling Weights

Region	≤50% eligible for free or reduced-price lunch	>50% eligible for free or reduced-price lunch
Midwest	4.59	4.61
Northeast	4.56	4.57
South	4.58	4.57
West	4.58	4.55

The survey asked respondents who were not MI teachers but who taught in a school that offered MI classes to provide the contact information for an MI teacher at their school. We

then sent the survey to the referred MI teacher. If the referred MI teacher completed the survey, we used the responses from that MI teacher rather than the original contact. This occurred for 47 schools.

Five schools that indicated that they had MI classes were recoded as non-MI schools because their description of MI provided in the open-ended responses did not align with the study's definition. Two teachers that indicated that they taught MI classes were recoded as non-MI teachers because they did not teach MI classes to middle-grades students.

SURVEY ADMINISTRATION

The online survey was administered from April to June 2017. As an initial step, we mailed a letter to mathematics educators and principals to provide information about the survey. Then, we sent these same contacts an email with an online survey link and followed up with email reminders (a maximum of 11 times) and one phone call to encourage them to complete the survey. When the survey was sent to a principal instead of a mathematics contact, we sent four follow-up emails and called once to ask the principals to identify an appropriate contact. If we replaced a school or were able to find a mathematics contact for a school where the survey was originally sent to the principal, the new contact received four or five follow-up emails. Respondents were given the option to receive a $10 Amazon gift card for completing the survey.

DATA

The findings in this study are based on the 876 schools that responded to the survey and answered at least the question on whether or not the school had MI classes during the 2016–17 school year (a response rate of 43%; Table 4). Ninety-one percent of respondents indicated that they had a teaching role in their school, 8% had administrative roles, and 1% had other roles (e.g., testing coordinator); 72% indicated that they taught a general education mathematics class, and 35% indicated that they taught MI class(es).

The response rates for each stratum were greater than 40% except for schools in the Northeast with more than 50% of students eligible for FRPL. The response rates were highest for schools in the Midwest with 50% or fewer students eligible for FRPL (51%) and lowest for schools in the Northeast with more than 50% of students eligible for FRPL (32%). The number of schools that responded to the survey exceeded the minimum sample size required to estimate the proportion of schools with MI classes. Further, 609 of 876 schools reported that they had MI classes, which exceeded the minimum sample size required for estimating proportions for the subset of schools that had MI classes.

Table 4. Response Rates for Each Stratum (Region and Free and Reduced Price Lunch)

Region	≤50% eligible for free or reduced-price lunch	>50% eligible for free or reduced-price lunch	All
Midwest	51%	46%	48%
Northeast	47%	32%	39%
South	46%	43%	44%
West	43%	40%	42%
All	47%	41%	43%

NON-RESPONSE ANALYSIS

Following the Statistical Guidelines of the National Center for Education Statistics (2012), we conducted a unit non-response bias analysis to determine whether there were differences in the characteristics of schools that did and did not respond to the survey. We used a design-based F-test (that is, a weighted chi-squared test) for categorical variables and t-tests for continuous variables to determine whether the characteristics of schools that responded to the survey were different from the characteristics of schools that did not respond. There were significant differences in locale, region, school level (middle, primary, other), percentage of students in the school eligible for FRPL, percentage of students in the district with limited English proficiency, and percentage of students in the district with Individualized Education Plans (Table 5). There were no significant differences in the number of students in the school, number of middle-grades students in the school, designation as a Title I school, or number of public school students in the district. Requests to complete the survey were more successful when we emailed mathematics contacts directly than when we asked principals to forward the survey to an appropriate educator (in schools where we were unable to identify a mathematics contact through other means). As with all non-response analyses, we were only able to compare the characteristics where data were available; it could be that the schools differed in some other ways that we were not able to capture.

Table 5. Characteristics of Respondents and Non-respondents

	Characteristics of respondents (n=876)		Characteristics of non-respondents (n=1,148)		Test for differences	
School Characteristics						
Locale					3.20**	0.007
Large city	28%	241	33%	382		
Mid-size city	9%	82	11%	121		
Small city	10%	87	7%	86		
Large suburb	43%	374	41%	476		
Mid-size suburb	7%	58	5%	54		
Small suburb	4%	34	3%	29		
Region					3.40	0.017
Midwest	26%	225	21%	240		
Northeast	22%	189	26%	300		
South	31%	275	30%	344		
West	21%	187	23%	264		
School level					5.16**	0.006
Primary (K–8)	23%	204	29%	337		
Middle (4–9)	72%	631	67%	771		
Other (includes high school grades)	5%	41	3%	40		
Number of middle-grades students	600	876	582	1,148	1.07	0.286
Number of students	730	876	732	1,148	0.12	0.901
Percentage FRPL	56%	876	59%	1,148	2.80**	0.005
50% or fewer students eligible for FRPL	44%	876	39%	1,148	2.73**	0.006
Title 1 schools	75%	876	78%	1,148	1.91	0.167
District Characteristics						
Percentage limited English proficiency	10%	876	11%	1,148	3.49**	0.001
Percentage with IEPs	14%	876	14%	1,148	2.01**	0.044
10 largest districts	12%	876	17%	1,148	2.7**	0.005
Number of public school students in the district	63,246	876	64,254	1,148	0.20	0.839
Respondent Characteristics						
Original contact type					98.18**	0.000
Mathematics contact	96%	838	81%	928		
Principal	4%	38	19%	220		

** p<.05

Data Source: U.S. Department of Education, National Center for Education Statistics, Common Core of Data (CCD), 2014–15. Retrieved from https://nces.ed.gov/ccd/pubschuniv.asp

WEIGHTS

To develop non-response weights, we estimated a logistic regression with a dichotomous outcome variable that indicated response status (1 = response, 0 = non-response) and explanatory variables that included the school characteristics, district characteristics, and contact type that were significantly different between respondents and non-respondents. We used the base sampling weights for the models. We compared the base model to alternative specifications and selected the model with the lowest Bayesian Information Criterion (BIC).

The final non-response propensity model included the following characteristics: region (with Midwest as the reference category); school level (with middle school as the reference category); number of public school students in the district; percentage of students with limited English proficiency in the district, an indicator for whether the respondent was in one of the 10 largest districts in the country; and an indicator for whether the original contact was a principal (with mathematics contact as the reference category; Table 6). The non-response weight for each school is equal to the inverse of the estimated probability of response. We adjusted the base sampling weights for non-response by multiplying each school's base sampling weight by its non-response weight.[2]

Table 6. Final Non-response Propensity Model

Dependent variable=responded (1=yes; 0=no)	Coefficient	Standard error
Region (reference=Midwest)**		
Northeast	-0.276*	0.143
South	-0.275**	0.131
West	-0.194	0.146
School level (reference=middle school)**		
Primary	-0.164	0.114
Other	0.502**	0.248
Percentage limited English proficiency	-1.372**	0.573
Total number of public school students in district	0.002**	0.001
Original contact type (reference=principal)		
Mathematics contact	1.605***	0.194
10 largest districts in the country	-0.304	0.213
Constant term	-1.409***	0.225
Pseudo R2	0.048	
AIC	5.968	
BIC	-3,273	

*** p<0.01, ** p<0.05, * p<0.1

Note: The chi-squared test statistics for the joint significance of regions and school levels was 7.68 (prob>chi2=0.053) and 6.04 (prob>chi2=0.048) respectively.Analysis

[2] The weights were not trimmed because the maximum weight was less than 5 times the mean weight.

ANALYSIS

Prior to conducting any analysis of survey items, we reviewed the open-ended responses for items with an "other" category and determined whether the responses could be recoded to fit within one of the existing response options. We also grouped the remaining "other" responses into new categories to be able to report on the common themes. We assessed reliability by examining the consistency of responses across questions. For example, 94% of teachers who reported that one of their roles was as an MI teacher for mathematics later in the survey reported that they taught an MI class in 2016–17. We further examined whether the structure of schools' MI classes aligned with their reported challenges and found that they were aligned as expected. For example, 74% of schools that reported having more than 15 students in MI classes reported that a challenge was having class sizes that were too large. In contrast, only 28% of schools that had less than 15 students in MI classes indicated that class size was a challenge.

We calculated frequencies for each survey item and grouped the responses based on the MI status of the schools (all schools, schools that had MI classes, and schools that did not have MI classes). We also calculated frequencies for the items that were asked only if the respondent was an MI teacher. The results for these items are considered exploratory because we identified a nationally representative sample of schools, not a nationally representative sample of MI teachers. The unit non-response-adjusted base sampling weights were used in all analyses.

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ABOUT THE *STRENGTHENING MATHEMATICS INTERVENTION* PROJECT

The ***Strengthening Mathematics Intervention*** project, funded by the National Science Foundation, is studying the ways in which schools provide support to struggling mathematics learners in the middle grades. In addition to the national survey described in this report, EDC conducted observations of mathematics intervention classes and interviewed teachers and mathematics leaders. Drawing on these findings, staff are creating and piloting a professional development program specifically for teachers of mathematics intervention classes, helping to build their knowledge and practices for supporting struggling learners in the middle grades.

ADDITIONAL MATERIALS

The Executive Summary, survey instrument, and supporting data tables are available at edc.org/accessmath. For more information, contact Amy Brodesky at abrodesky@edc.org.

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