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WHO WILL TEACH MATHEMATICS IN GRADES 7 AND 8?

A key to the quality of mathematics instruction in Connecticut middle schools is whom districts will hire to teach seventh- and eighth-grade mathematics. Research shows that teacher expertise is the most important in-school factor in student achievement. But, will there be enough teachers endorsed in mathematics? Or will districts have to choose teachers with marginal mathematics training? Will middle school teachers be able to teach algebra 1 effectively? And will the most qualified teachers be drawn to the wealthiest districts? This Bulletin will rely on data gathered from several sources, primarily the *Biennial Report of Science and Mathematics Enrollment*, to examine these questions.

Impending Shortage of Mathematics-Endorsed Teachers, Grades 7-12

In recent years, the supply of mathematics teachers has been sufficient to meet the demand. The 1998 Fall Hiring Report found that 97 districts sought to fill 234 mathematics positions in all grades. Although they received an average of 21 applications, six positions went unfilled because a qualified person could not be found, and 12 positions were filled by people judged by the districts to be minimally qualified or by people with substandard certificates. These factors, along with the number of teachers endorsed in mathematics in the prior year, combined to make mathematics the 18th ranked shortage area for 1998-99.

However, the Connecticut State Department of Education now projects that the supply of certified mathematics teachers across all grades will be insufficient to meet demand in the next five years. With a projected average shortfall of 85 teachers per year, mathematics could become the number one shortage area.

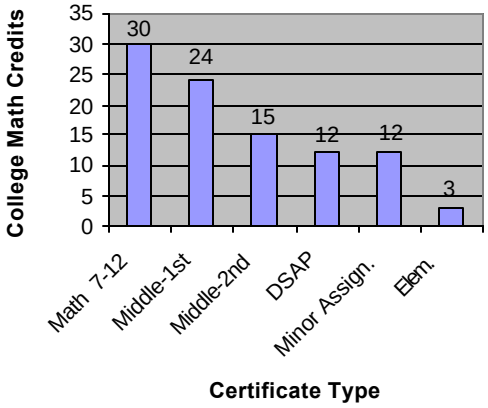
Certification Requirements

To teach mathematics in high school, a person needs a mathematics endorsement. In the middle grades, however, people with an obsolete but valid elementary endorsement through Grade 8 may teach mathematics. The training in mathematics for these teachers can be substantially less than teachers with a mathematics endorsement and well below the minimum recommended by the National Council of Teachers of Mathematics (NCTM). NCTM recommends four years of high school mathematics followed by a minimum of five courses in content mathematics in college for mathematics teachers in Grades 5-8.

The mathematics coursework requirements for people wishing to teach mathematics in Grades 7 and 8 have been upgraded recently with the introduction of the mathematics middle grades endorsement. However, since people with valid certificates earned before the requirements were changed can still teach, it is valuable to examine earlier requirements for initial certification as well.

People who hold the following endorsements can teach mathematics in Grades 7 and 8: PK-8; Grades 1-8; Grades 4-8; Mathematics, 7-12; and Mathematics, Middle Grades. People who hold bilingual or special education certificates can also teach mathematics to these subgroups of students. Figure 1 presents the college mathematics coursework required to teach mathematics in Grades 7 and 8 under different endorsement categories and certificate types.

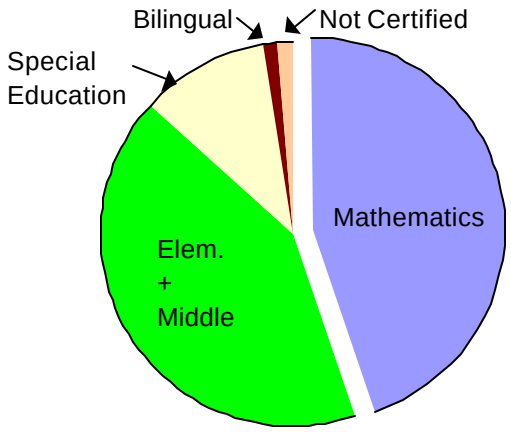
Figure 1. College Mathematics Credits Required for Certification



The two elementary (PK-8 and Grades 1-8) endorsements required that the person have one course in mathematics. While they have not been issued since 1989, there are still 5,514 active certificates held by people not currently teaching. The middle grades 4-8 endorsement also required one course in mathematics. While it has not been issued since 1998, there are still 1,806 active certificates held by people not currently teaching. On July 1, 1998, the

mathematics middle grades endorsement was implemented. It requires 24 credits in mathematics if a person has 15 credits in another subject (Middle-1st) or 15 credits in mathematics if a person has 24 credits in another subject (Middle-2nd). The mathematics, 7-12 endorsement requires 30 credits in mathematics plus 9 credits in a related area or a mathematics major. Only the 7-12 and new middle school mathematics endorsements require that a person pass the Praxis II examination in mathematics. Special education teachers currently need no credits in mathematics. Bilingual teachers currently need no specific courses, but must demonstrate "experience, knowledge or proficiency in the areas such teacher is to serve."

Figure 2. Endorsement of Mathematics Teachers, Grades 7-8; 1997



The above represents the minimum coursework requirements for initial certification. Certified teachers may teach up to two mathematics courses per year under a Minor Assignment if they have certification in a secondary subject plus at least 12 credit hours in mathematics. (At the time of this study, the requirement was six semester hours.) This can be reissued if six additional credit hours are taken. A college graduate can also teach mathematics under a Durational Shortage Area Permit (DSAP). This would require 12 credit hours in mathematics the first year and enrollment in a teacher preparation program. It may be reissued with nine more credit hours.

Endorsement of Mathematics Teachers in Grades 7 and 8

In 1997, there were 1,107 teachers of mathematics in Grades 7 and 8. Figure 2 presents the endorsement under which they taught.

In 1997, almost 45 percent of the teachers of mathematics in Grades 7-8 held a 7-12 mathematics endorsement, 29 percent held an elementary endorsement covering Grade 8 and about 13 percent held the middle grades (4-8) endorsement (the mathematics middle grades endorsement was not in effect at this time). Twelve percent of these teachers held a special education or bilingual endorsement. A total of 14 teachers (1.3%) were either not on the certification file or held an endorsement inappropriate for Grade 7-8 mathematics. This distribution has changed little since 1991.

College Credits in Mathematics

As previously illustrated, fewer than half of the approximately 1,100 Grades 7 and 8 mathematics teachers hold certification endorsements that require the mathematics coursework that NCTM recommends. This is not to say they do not have the courses; merely, they are not required. Table 1 examines the actual undergraduate and graduate coursework in mathematics self-reported by the teachers of seventh and eighth grade mathematics in the 1997-98 school year. The elementary and middle-grades endorsements have been combined because in 1997 they had the same mathematics coursework requirements.

Table 1. College Credits in Mathematics by Endorsement Area of Grades 7 and 8 Mathematics Teachers

	Credits			
Endorsement	**3-9**	**10-15**	**16-29**	**30 or More**
Mathematics	1.2%	1.8%	22.7%	74.3%
Elementary, Middle Grades	23.5%	30.2%	26.1%	20.2%
Special Education	70.1%	17.8%	3.7%	7.5%
Bilingual	38.5%	7.7%	15.4%	38.5%
Not Certified	30.8%	30.8%	23.1%	15.4%
TOTAL	18.2%	15.8%	22.3%	43.6%

Almost two-thirds of the teachers of mathematics in Grades 7 or 8 reported taking 16 or more mathematics credits in college, thus meeting the NCTM recommendation. Among those who hold a mathematics endorsement, over 74 percent had 30 or more credits. In 1991, the comparable figure was 68 percent. About one-quarter of those teaching mathematics under an elementary or middle school endorsement reported taking nine or fewer credits of college mathematics. Five of the 14 people not properly certified reported earning 16 or more college credits in mathematics. A total of 21 teachers either did not record mathematics credits or had zero. We were not able to discriminate between the two cases. This represents almost two percent of the teachers of mathematics. Of the 77,023 seventh- and eighth-graders taking mathematics, 6,570, or about nine percent, were taught by teachers who reported taking nine or fewer mathematics credits in college.

Mathematics Credentials by ERG

How are the mathematics resources spread out across the state? Do poorer or smaller communities employ mathematics teachers with lesser credentials than richer or

larger communities? Table 2 presents the percentage of Grade 7 pre-algebra teachers who hold a mathematics endorsement and who reported 16 or more credits in mathematics for each of the state's Educational Reference Groups (ERGs).

Table 2. Teachers of Grade 7 Pre-Algebra: Percent Math Endorsed and Percent with 16 Credits or More

Education Reference Group (ERG)	Percent Math Endorsed	Percent with 16 Math Credits Or More
A	89.5	89.5
B	70.0	88.0
C	62.9	74.3
D	52.8	77.7
E	36.4	54.5
F	63.4	63.4
G	35.8	71.4
H	37.5	68.8
I	55.5	71.1
TOTAL	57.4	78.9

Over 57 percent of the seventh-grade pre-algebra teachers were endorsed in mathematics and almost 79 percent had 16 or more credits of mathematics in college (roughly the equivalent of a mathematics minor). The percentages varied considerably by ERG. Almost 90 percent of these teachers in ERG A were endorsed in mathematics compared to about 36 percent in ERGs E, G and H. The percentage of pre-algebra teachers from ERG I districts who worked under a mathematics endorsement was only slightly below the state average. The differences, while present, were less pronounced when college coursework in mathematics was evaluated. The percentage of teachers with 16 or more college mathematics credits varied from nearly 90 percent in ERGs A and B to a low of about 55 percent in ERG E. About 70 percent of the pre-algebra teachers from ERGs G, H and I had earned the equivalent of a mathematics minor.

Allocation to Courses

There are three levels of mathematics that have been differentiated in Grade 7 – remedial, regular and accelerated or pre- algebra and four levels in Grade 8 – remedial, regular, accelerated or pre-algebra and algebra 1. Table 3 shows that mathematics background is considered when course assignments are made.

The higher the level of mathematics in Grades 7 and 8, the more likely the teacher will be endorsed in mathematics or have earned at least 16 or more mathematics credits in college, roughly equivalent to the NCTM recommendation of college mathematics coursework for teachers in middle grades. About 48 percent of Grade 7 mathematics teachers schools. The patterns hold both within and between held a mathematics endorsement compared to almost 58 percent of

Table 3. Teachers of Mathematics in Grades 7 or 8: Percent Math Endorsed and Percent with 16 Math Credits or More, by Course, 1997

Course	Percent Math Endorsed	Percent with 16 Math Credits Or More
Grade 7 Remedial	25.4	44.6
Grade 7, Regular	46.0	67.1
Grade 7, Accelerated	57.2	77.6
Grade 8, Remedial	32.9	53.7
Grade 8, Regular	50.4	74.2
Grade 8, Enriched	66.5	83.6
Grade 8, Algebra I	70.1	87.2
TOTAL	52.5	72.9

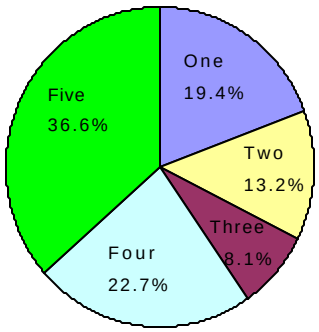
Grade 8 mathematics teachers. The percentages with at least 16 credits or more in mathematics were 70.4 and 77.6, respectively. Within Grade 7, both the percentage with a mathematics endorsement and the percentage with 16 college mathematics credits increase from teachers of remedial mathematics to accelerated mathematics (pre-algebra). The same pattern is evident in Grade 8 for teachers of remedial mathematics through Algebra I. In 1997, there were 17,162 students, or over 22 percent of the students taking Grade 7 or 8 mathematics, who were instructed by teachers with 16 or fewer college mathematics credits.

Full or Partial Mathematics Teaching Load

To determine what type of teacher a district needs, it is useful to examine how many mathematics courses are taught by each teacher. Figure 3 presents the numbers of sections of mathematics that were taught by the seventh- and eighth-grade mathematics teachers.

For over 67 percent of the teachers of mathematics in

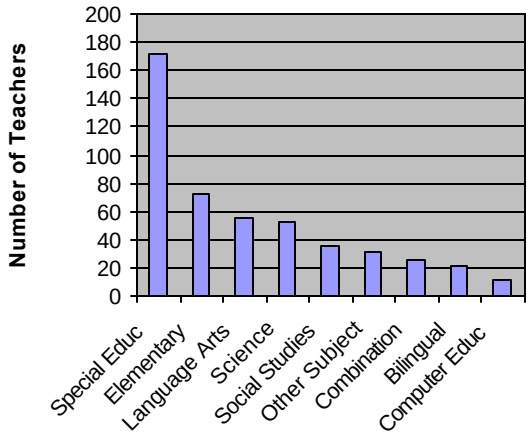
Figure 3. Number of Mathematics Sections Taught



Grades 7 or 8, mathematics was their predominant subject. About 19 percent taught only one section of mathematics and another 13 percent taught two sections. An analysis of the Department's staff file (data gathered on form ED163) revealed that those teaching less than five mathematics

classes were not part time, but rather, teaching other

Figure 4. Subjects Taught Outside of Mathematics



subjects (see Figure 4).

The 1997 Certified Staff database encoded almost 44 percent of mathematics teachers in Grades 7 and 8 as teaching a subject other than mathematics. Special education was cited most often, followed by elementary and language arts (English or reading). If one assumes that the special education, elementary, combination and bilingual categories indicate people teaching mathematics plus two other content areas, then almost 27 percent of our mathematics teachers in Grades 7 and 8 are truly generalists.

Credentials of New Mathematics Teachers

In 1997 there were 107 teachers of mathematics in Grades 7 or 8 working under mathematics or elementary endorsements who reported zero or one year of teaching experience, compared to only 19 in 1991. The number of college mathematics credits that they had earned improved in those six years. In 1991, about 36 percent of the new mathematics teachers working under an elementary endorsement had 16 or more college credits in mathematics. By 1997, the figure had improved to 48 percent. For people with the mathematics endorsement, almost 63 percent reported earning 30 hours in mathematics in 1991 compared to about 91 percent in 1997.

Changing Level of Instruction

To effectively strengthen the mathematics curriculum in Grades 7 and 8, teachers will need more college mathematics. Table 3 shows that districts prefer to place teachers with more mathematics credentials in higher level courses. Table 4 shows how the distribution of classes in mathematics has changed between 1991 and 1997.

In Grade 7, enriched classes (pre-algebra) constituted roughly 24% of the mathematics classes offered in 1997,

Table 4. Level of Mathematics Instruction by Grade, 1991 and 1997.

	Grade 7		Grade 8	
Level	1991	1997	1991	1997
Remedial	15.9%	12.5%	13.5%	9.7%
Regular	64.2%	63.1%	49.6%	36.5%
Enriched	19.9%	24.4%	20.3%	28.1%
Advanced			16.6%	25.6%

compared to just under 20 percent in 1991. In Grade 8, advanced classes in algebra I, integrated mathematics I, and geometry represented over 25 percent of the classes taught in 1997, compared to over 16 percent in 1991. Concurrently, there was almost an 8-percentage point increase in the enriched classes (pre-algebra). The number of regular classes dropped by about 13 percentage points and the number of remedial classes dropped by almost 4 percentage points.

Summary

Upgrading middle school mathematics instruction will require teachers who have solid preparation in mathematics content. This process is underway as more students are taking accelerated or advanced courses. However, 34 percent of the teachers of mathematics in Grades 7 and 8 in 1997 did not meet the minimum mathematics preparation recommended by NCTM. In July 1998, the Department introduced middle school endorsements that require 24 credits in one subject and 15 credits in additional subjects. This should provide districts with teachers with better mathematics training and with the flexibility of assigning a teacher to more than one subject.

How rapidly this change makes a difference in the classroom may be hindered by the prospective shortage of teachers endorsed in mathematics. Districts struggling to find people may be able to shift a mathematics-endorsed teacher from a middle school up to the high school. It is too soon to tell whether a person holding middle school credentials or a person holding a valid but dated K-8 elementary endorsement will fill the vacated middle school mathematics positions. The Department will monitor the mathematics course work taken by the teachers of middle school mathematics to ensure that the reforms in certification have the intended effect of raising the quality of mathematics instruction.

This Data Bulletin was based upon information from ED161, Biennial Report of Science and Mathematics Enrollments; the Department's teacher certification files; ED156, Fall Hiring Report; ED163, Certified Staff Data Form; *and Public School Educator Supply and Demand in Connecticut: A Look Toward the 21st Century.* For further information contact Peter Prowda at (860) 566-7585, or by e-mail at peter.prowda@po.state.ct.us