THE PREPARATION AND DEVELOPMENT OF MATHEMATICS TEACHERS ACCORDING TO NAEP

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Goals of the Session

- Discuss the professional background of mathematics teachers, based results of the NAEP teacher questionnaire.

- Discuss our examination of the longitudinal data identifying trends in teacher responses.

- Share findings that address the link between teachers’ education and professional experience to student achievement on NAEP.
What is NAEP?

- National Assessment of Educational Progress
- Math assessment is given every two years to students in Grades 4 and 8, and every four years to Grade 12 students
- Only nationally representative measure of student achievement in the United States
Current Analyses

- Used 1990-2011 National Public data for grades 4 & 8
- Not all items are posed on each survey, so in some cases longitudinal data does not include data from every NAEP administration
- The NAEP sample is based on a random sampling of students, not teachers. Thus, the results should be reported as the percentage of students who have teachers, not the percentage of teachers.
NAEP Results

- NAEP results show growth in student achievement for both 4th and 8th grades from 1990 to 2011.

- Average Scale Scores in 2011:
  - 4th Grade: 241
  - 8th Grade: 284

Source: National Center for Educational Statistics
Undergraduate Majors of Teachers
Undergraduate majors of teachers of 8th graders by percentage: 2003 to 2011
Scores of grade 8 students by undergraduate major of teacher: 2003 to 2011
Undergraduate majors of teachers of 4th graders by percentage: 2003 to 2011

- Education including elementary or early childhood:
  - 2003: 67%
  - 2005: 62%
  - 2007: 59%
  - 2009: 62%
  - 2011: 58%

- English:
  - 2003: 5%
  - 2005: 5%
  - 2007: 4%
  - 2009: 4%
  - 2011: 4%

- Reading or language arts:
  - 2003: 4%
  - 2005: 3%
  - 2007: 4%
  - 2009: 3%
  - 2011: 3%

- Another language arts subject:
  - 2003: 1%
  - 2005: 1%
  - 2007: 1%
  - 2009: 1%
  - 2011: 1%

- Mathematics education:
  - 2003: 2%
  - 2005: 1%
  - 2007: 1%
  - 2009: 1%
  - 2011: 1%

- Another mathematics subject:
  - 2003: 1%
  - 2005: 1%
  - 2007: 1%
  - 2009: 1%
  - 2011: 1%
Undergraduate majors

- For teachers of both 4th and 8th graders, the number of undergraduate degrees in education are declining.
- What is the cause?
Graduate Majors of Teachers
Graduate majors of teachers of 8th graders by percentage: 2003 to 2011
Scores of grade 8 students by graduate major of teacher: 2003 to 2011
Graduate majors of teachers of 4th graders by percentage: 2003 to 2011

- Education with elementary: 44, 42, 40, 37
- English: 1, 1, 1, 1
- Reading or language arts: 11, 9, 9, 9
- Another language arts subject: 3, 2, 2, 2
- Mathematics: 1, 1, 1
- Mathematics education: 2, 1, 1, 1
Graduate majors

- For teachers of both 4th and 8th graders, teachers’ graduate degrees in education are declining, particularly at the 4th grade level.
- Type of graduate degree does not matter much for 8th graders.
Highly Qualified Teachers
What does it mean to be “highly qualified”?

To be highly qualified a teacher must be fully certified (no emergency certifications), have a bachelor’s degree, and have demonstrated subject matter competency in each core academic subject taught.

http://www.asdk12.org/NCLB/teachers/teacher_faq.asp#who
How do elementary teachers demonstrate subject matter competency?

Elementary Teachers (K-6) can demonstrate that they are highly qualified in any one of the following ways:

- Passing score on a state-approved elementary Praxis II exam or
- Passing score (100 points) on the state’s HOUSSE matrix or
- National Board Certification (NBC) as an Early Childhood Generalist for grades K-3, Middle Childhood Generalist for grades 3-6, or Early Adolescence Generalist for grade 6 or
- Pass the State Performance Review or
- State reciprocity

http://www.asdk12.org/NCLB/teachers/teacher_faq.asp#who
How do middle and high school teachers demonstrate subject matter competency?

Secondary (Middle & High School) and Content Specialist Teachers must be highly qualified in each core subject they teach. They can become highly qualified in any one of the following ways:

- Degree or advanced degree in the core subject or
- College major in the core subject or
- Major equivalent in the core subject (30 semester credits or the equivalent) or
- Passing score on state-approved Praxis II exam in core content or
- Passing score (100 points) on the HOUSSE or
- National Board Certification in the content area or
- Pass the State Performance Review or
- State reciprocity

http://www.asdk12.org/NCLB/teachers/teacher_faq.asp#who
This school year, are you a Highly Qualified Teacher according to your state’s requirements?

4th grade

- 2009: Highly Qualified
- 2011: Highly Qualified in at least 1 subject

8th grade

- 2009: Highly Qualified
- 2011: Highly Qualified in at least 1 subject

Legend:
- Red: Highly Qualified
- Orange: Highly Qualified in at least 1 subject
- Blue: Not Highly Qualified
Highly Qualified

✓ Having a highly qualified teacher had no significant effect on 4th graders’ scores.

✓ But for 8th graders, having a highly qualified teacher mattered!
Certification of Teachers
What does “alternative certification” mean?

The National Center for Alternative Certification
- established in September 2003 with grant from the U.S. Department of Education
- clearinghouse for information about alternative routes to certification in the U.S.
- [http://www.teach-now.org](http://www.teach-now.org)

According to this site, “alternative routes to teacher certification are state-defined routes through which an individual who already has at least a bachelor’s degree can obtain certification to teach without necessarily having to go back to college and complete a college, campus-based teacher education program.”
In 2010
✓ 48 states and the District of Columbia report having at least some type of alternate route to teacher certification (Alaska and Oregon do not)
✓ Altogether, 136 state-defined alternate routes to teacher certification now exist
✓ Nearly 600 alternate route programs are implementing these alternative routes
1985 – 2009: alternative certifications

Number of Teachers Certified Through Alternate Routes, 1985-2009

- Year | Number Certified
- 1985-86 | 275
- 1986-87 | 550
- 1987-88 | 1,303
- 1988-89 | 3,891
- 1989-90 | 5,690
- 1990-91 | 3,034
- 1991-92 | 3,863
- 1992-93 | 6,223
- 1993-94 | 6,099
- 1994-95 | 6,932
- 1995-96 | 7,158
- 1996-97 | 6,028
- 1997-98 | 12,283
- 1998-99 | 15,879
- 1999-00 | 20,355
- 2000-01 | 25,970
- 2001-02 | 33,225
- 2002-03 | 38,519
- 2003-04 | 50,000
- 2004-05 | 59,000
- 2005-06 | 57,000
- 2006-07 | 62,000
- 2007-08 | 59,000
- 2008-09 | 59,000
Did you enter teaching through an alternative certification program?

4th grade

8th grade

[Bar charts showing data for 2009 and 2011 for 4th and 8th grade.]

YES  NO

2009 2011

2009 2011
Students that DID qualify for National School Lunch Program...

4th grade

- 2009: Alternative Certification - 220, Traditional Certification - 222.5
  - 2011: Alternative Certification - 225, Traditional Certification - 230

8th grade

- 2009: Alternative Certification - 260, Traditional Certification - 265
  - 2011: Alternative Certification - 270, Traditional Certification - 275
Students that DID NOT qualify for National School Lunch Program…

4th grade

<table>
<thead>
<tr>
<th>Year</th>
<th>Alternative Certification</th>
<th>Traditional Certification</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>250</td>
<td>245</td>
</tr>
<tr>
<td>2011</td>
<td>250</td>
<td>250</td>
</tr>
</tbody>
</table>

8th grade

<table>
<thead>
<tr>
<th>Year</th>
<th>Alternative Certification</th>
<th>Traditional Certification</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>290</td>
<td>290</td>
</tr>
<tr>
<td>2011</td>
<td>295</td>
<td>300</td>
</tr>
</tbody>
</table>
For both 4th and 8th graders, if they had a teacher that entered teaching through alternative certification, they tended to score significantly lower than those students having traditional certified teachers.

For students that DO qualify for School Lunch Program, the impact was greater at 4th grade.

For students that DO NOT qualify for School Lunch Program, the impact was greater at 8th grade.
Instructional Time
How many hours of mathematics instruction do your student receive in a typical week?
The number of hours devoted to teaching mathematics decreases between 4th and 8th grade.

- A majority of teachers claim that 4th grade students receive 5 to 7 hours of mathematics per week.
- A majority of teachers claim that 8th grade students receive 3 to 5 hours of mathematics per week.

The largest change among time devoted to instruction is mathematics in the 4th grade.

- 2005: 16% of teachers said students received more than 7 hours.
- 2011: 31% of teachers said students received more than 7 hours.
Professional Development
During the last two years, did you participate or lead any of the
following professional development activities related to the

teaching of math?
During the last two years, did you participate or lead any of the following professional development activities related to the teaching of math?

**Percentage of Students’ Teachers**

<table>
<thead>
<tr>
<th>Professional Development Activity</th>
<th>2003</th>
<th>2005</th>
<th>2007</th>
<th>2009</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>College Course</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workshop/Training</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conference/Meeting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observational Visit to Other School</td>
<td>17</td>
<td>20</td>
<td>50</td>
<td>70</td>
<td>60</td>
</tr>
<tr>
<td>Mentoring/Coaching</td>
<td>28</td>
<td>30</td>
<td>28</td>
<td>30</td>
<td>36</td>
</tr>
<tr>
<td>C&amp;I Committee</td>
<td>31</td>
<td>33</td>
<td>34</td>
<td>39</td>
<td>47</td>
</tr>
<tr>
<td>Study Group</td>
<td>37</td>
<td>36</td>
<td>35</td>
<td>40</td>
<td>47</td>
</tr>
<tr>
<td>Teacher Collaborative</td>
<td>36</td>
<td>35</td>
<td>36</td>
<td>35</td>
<td>36</td>
</tr>
<tr>
<td>Individual Research</td>
<td>40</td>
<td>43</td>
<td>40</td>
<td>47</td>
<td>47</td>
</tr>
<tr>
<td>Independent Reading</td>
<td>28</td>
<td>27</td>
<td>24</td>
<td>28</td>
<td>30</td>
</tr>
<tr>
<td>Co-teaching/Team teaching</td>
<td>34</td>
<td>36</td>
<td>36</td>
<td>37</td>
<td>37</td>
</tr>
<tr>
<td>Math Specialist Consult</td>
<td>20</td>
<td>28</td>
<td>26</td>
<td>30</td>
<td>36</td>
</tr>
</tbody>
</table>

- **Note:** The percentages represent the percentage of students’ teachers participating in each activity over the years 2003 to 2011.
Trend data suggests that more students have teachers who are participating in professional development opportunities.

Some possible explanations

- Greater access to math coaches and instructional specialists
- Availability and advertisement of professional development via web and/or social media
- Programs sponsored through Math-Science Partnerships (MSP)

Note that the number of students with teachers pursuing additional college courses has remained relatively stable and low (≤ 20%)
PD Activity Participation

4th grade trends in moderate to large extent categories
PD Activity Participation

8th grade trends in moderate to large extent categories
Professional Development Activities

- Of the teachers surveyed, the activity with highest participation rate at both 4th and 8th grades is related to content standards.
- At 4th grade, the activity with lowest participation is related to the effective use of calculators.
- At 8th grade, the activity with lowest participation is related to ability grouping.
Are students assigned to this class by ability?

4th Grade

8th Grade

- No
- Yes
Are students assigned to this class by ability?

4th Grade

8th Grade

[Graphs showing trends over years for 4th and 8th grades, with 'No' and 'Yes' categories indicated.]
Between Class Ability Grouping

- The percentage of students who are assigned to classes by ability are relatively stable historically:
  - About 20% of 4th graders
  - About 60% of 8th graders

- In both cases, students who are assigned to classes based on ability outscore their peers.
Do you create groups within this class for mathematics instruction on the basis of ability?
Do you create groups within this class for mathematics instruction on the basis of ability?
Within Class Ability Grouping

- The trend in both grades shows that the practice of grouping students by ability is increasing.
- However, the effects on student achievement show that at both levels, students who are not grouped by ability perform higher than their peers.
- ALARMING! The trend is moving toward a practice that appears less effective.
Interesting Questions that Emerge

- Why is it that students who are ability grouped between classes perform higher than their peers, but students who are ability grouped within classes perform lower than their peers?
- What are the implications of these results for current reform efforts that promote high expectations for all?
- Are the teacher questionnaire’s survey results misleading?
Calculator Use
Calculator Use for Math Lessons

- **4th Grade**
  - Not Permitted: 4
  - Restricted: 236
  - Unrestricted: 64

- **8th Grade**
  - Not Permitted: 9
  - Restricted: 284
  - Unrestricted: 34
Calculator Use on Tests

![Bar chart showing usage of calculators on tests for 4th and 8th grade students.](chart.png)

- **4th Grade**: Always - 70, Sometimes - 240, Never - 284
- **8th Grade**: Always - 29, Sometimes - 50, Never - 276
PD on Methods for Assessing Students in Mathematics

4th Grade

8th Grade

Not at all
Small Extent
Moderate Extent
Large Extent

2005 2007 2009 2011

2005 2007 2009 2011
Multiple-Choice Assessments

![Bar Chart]

The chart shows the frequency of multiple-choice assessments across different grade levels.

- **4th Grade**:
  - 1-2 times/week: 53
  - 1-2 times/month: 25
  - 1-2 times/year: 10
  - Never/Hardly Ever: 12

- **8th Grade**:
  - 1-2 times/week: 54
  - 1-2 times/month: 13
  - 1-2 times/year: 21
  - Never/Hardly Ever: 12

Legend:
- Green: 1-2 times/week
- Blue: 1-2 times/month
- Orange: 1-2 times/year
- Red: Never/Hardly Ever
Multiple-Choice Assessments

![Bar Chart]

- 1-2 times/wk
- 1-2 times/mo
- 1-2 times/yr
- Never/Hardly Ever

4th:
- 1-2 times/wk: 25
- 1-2 times/mo: 53
- 1-2 times/yr: 241
- Never/Hardly Ever: 10

8th:
- 1-2 times/wk: 13
- 1-2 times/mo: 54
- 1-2 times/yr: 281
- Never/Hardly Ever: 12

Total:
- 1-2 times/wk: 38
- 1-2 times/mo: 56
- 1-2 times/yr: 522
- Never/Hardly Ever: 22
Short or Long Written Responses

- 1 - 2 times/yr
- 1 - 2 times/mo
- Never or hardly ever

4th Grade:
- 1 - 2 times/yr: 40%
- 1 - 2 times/mo: 42%
- Never or hardly ever: 8%

8th Grade:
- 1 - 2 times/yr: 28%
- 1 - 2 times/mo: 45%
- Never or hardly ever: 15%
Short or Long Written Responses

<table>
<thead>
<tr>
<th></th>
<th>4th Grade</th>
<th>8th Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 2 times/wk</td>
<td>42</td>
<td>28</td>
</tr>
<tr>
<td>1 - 2 times/mo</td>
<td>241</td>
<td>285</td>
</tr>
<tr>
<td>1 - 2 times/yr</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>Never or hardly ever</td>
<td>234</td>
<td>282</td>
</tr>
</tbody>
</table>

- Green: 1 - 2 times/wk
- Blue: 1 - 2 times/mo
- Orange: 1 - 2 times/yr
- Red: Never or hardly ever
Differentiated Instruction
PD on Teaching Students from Diverse Backgrounds

Not at All
Small Extent
Moderate Extent
Large Extent

Not at All
Small Extent
Moderate Extent
Large Extent
Set Different Achievement Standards for Some Students – 4th Grade
Set Different Achievement Standards for Some Students – 8th Grade
Engage Some Students in Different Activities – 4th Grade

Not at All          Small Extent          Moderate Extent          Large Extent
237               240  241         239  240            238
240               241          240                  240

2009  2011

- 2009
- 2011
Engage Some Students in Different Activities – 8th Grade
Change Pace of Instruction for Some Students – 4th Grade

- Not at All: 242, 244
- Small Extent: 241, 243
- Moderate Extent: 239, 240
- Large Extent: 237, 238

Comparison between 2009 and 2011
Change Pace of Instruction for Some Students – 8th Grade

- Not at All: 289 (2009), 292 (2011)
- Moderate Extent: 281 (2009), 281 (2011)
- Large Extent: 276 (2009), 276 (2011)
Discussion

- How might NAEP data inform program and professional development initiatives?
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