COMPARISON OF PERFORMANCE ON NAEP MATHEMATICS RELEASED QUESTIONS: IOWA AND THE NATION

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Abstract—When results are released from the National Assessment of Educational Progress (NAEP) some questions from the assessment are also released. While not representative of the entire assessment, the questions can be used to supplement classroom instruction, provide additional insight into the content of the assessment, and show what students in Iowa know and can do. The NAEP released questions in mathematics indicate that Iowa students in grades 4 and 8 comprehend the Numbers and Operations subscale better than their national counterparts. However, differentiation on the other subscales is not as dramatic.

Background—The National Assessment of Educational Progress (NAEP) is the only nationally representative and continuing assessment of what America's students know and can do in various subject areas. Assessments are conducted periodically in mathematics, reading, science, writing, the arts, civics, economics, geography, and U.S. history. For the most recent results of assessments, visit the Nation's Report Card website (http://nationsreportcard.gov). To see NAEP data, information about the NAEP program, and a schedule of future and past assessments and studies, explore this website (http://nces.ed.gov/nationsreportcard).

Under the current structure, the Commissioner of Education Statistics, who heads the National Center for Education Statistics in the U.S. Department of Education, is responsible by law for carrying out the NAEP project. The National Assessment Governing Board, appointed by the Secretary of Education but independent of the Department, sets policy for NAEP and is responsible for developing the framework and test specifications that serve as the blueprint for the assessments.

NAEP does not provide scores for individual students or schools; instead, it offers results regarding subject-matter achievement, instructional experiences, and school environment for populations of students (e.g., fourth-graders) and groups within those populations (e.g., female students, Hispanic students). NAEP results are based on a sample of student populations of interest.

At the time of release of grade-level results on the NAEP, some questions from the assessment are also released. While not representative of the entire assessment, the questions can be used to supplement classroom instruction, provide additional insight into the content of the assessment, and show what students in Iowa know and can do.

Method—In this study a comparison of the results of the Main NAEP released questions in mathematics in grades four and eight was conducted. After each assessment, NAEP releases dozens of sample questions to the public. More than 2,000 questions are currently available. The questions can be used to supplement classroom instruction, provide additional insight into the content of the assessment, and show what students nationally or in each state or district know and can do. Since some questions must be kept secure for use in future NAEP assessments, only a portion of each NAEP assessment is released. Consequently, the released questions do not represent complete coverage of the content, cognitive skills, and range of difficulty in the NAEP assessment for a particular subject area. Although the questions released by NAEP are not representative of the whole assessment, they do provide some interesting findings that call for further research using the entire restricted-use data set. Multiple years of released questions were used to increase the number of questions that could be examined. (Security issues continue to keep Iowa Department of Education staff from accessing the restricted-use data set.)

Results and Discussion—

The findings of this study include:

Fourth Grade

- During the last decade, the gap between performance of the nation's public schools and Iowa's public schools in fourth-grade mathematics has closed significantly on all subscales.
- Students in Iowa scored significantly better on easy questions, but only slightly better on medium and hard questions, than did students across the nation.
- Differences between Iowa students and the nation's students on multiple-choice, constructed-response, and extended constructed-response questions were not evident.
- Iowa students' greatest gains since first tested in 1990 were in the easy questions in the Numbers and Operations subscale.

Eighth Grade

- During the last decade, the gap between performance of the nation's public schools and Iowa's public schools on eighth-grade mathematics has closed significantly on all subscales.
- Iowa students scored slightly, not significantly, better, no matter the difficulty of the question (easy, medium, and hard), than did students across the nation.

While Iowa continues to perform better than the nation as a whole, the gap between the performance of the nation's public schools and Iowa's public schools in fourth-grade mathematics has closed significantly during the last decade.

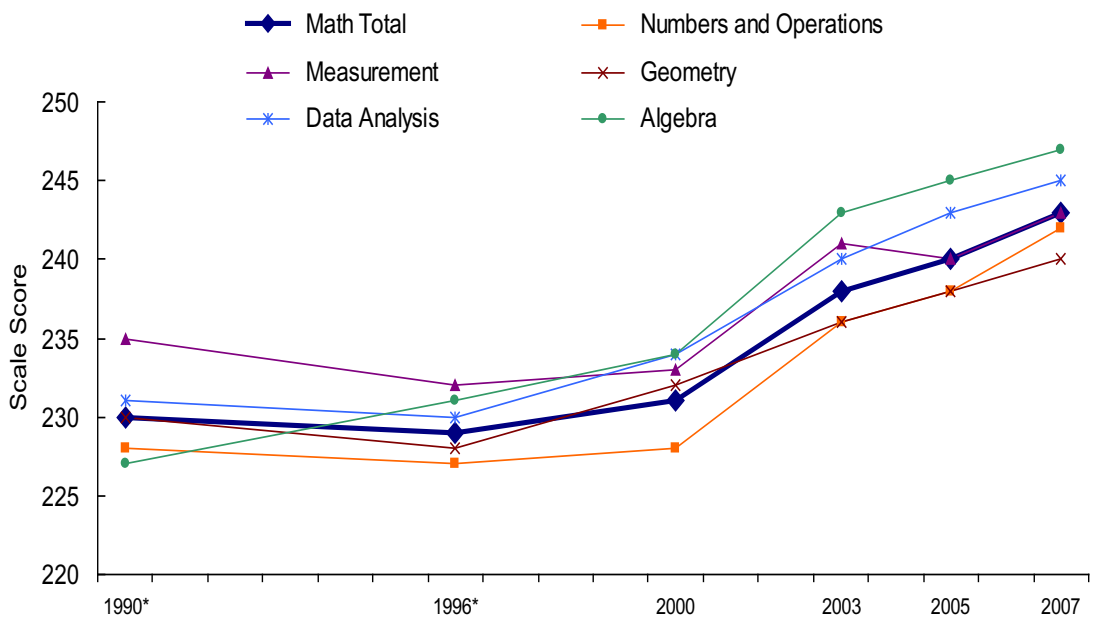
Table 1—NAEP Mathematics Subscale Scores for Iowa and the Nation Grade 4

		Math Total		Numbers and Operations		Measurement		Geometry		Data Analysis		Algebra	
Year	Jurisdiction	Scale Score	Dif (IA - US)	Scale Score	Dif (IA - US)	Scale Score	Dif (IA - US)	Scale Score	Dif (IA - US)	Scale Score	Dif (IA - US)	Scale Score	Dif (IA - US)
1990 [1]	Iowa	230		228		235		230		231		227	
	Nation	219	11**	216	12**	223	12**	221	9**	219	12**	218	9**
1996 [1]	Iowa	229		227		232		228		230		231	
	Nation	222	7**	219	8**	224	8**	224	4**	223	7**	226	5**
2000	Iowa	231		228		233		232		234		234	
	Nation	224	7**	222	6**	224	9**	225	7**	227	7**	229	5**
2003	Iowa	238		236		241		236		240		243	
	Nation	234	4**	232	4**	233	8**	233	3**	237	3**	240	3**
2005	Iowa	240		238		240		238		243		245	
	Nation	237	3**	235	3**	236	4**	236	2*	241	2	243	2**
2007	Iowa	243		242		243		240		245		247	
	Nation	239	4**	237	5**	238	5**	238	2*	243	2*	244	3**

[1]Accommodations were not permitted for this assessment.

Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1990, 1996, 2000, 2003, 2005, and 2007 Mathematics Assessments.
Note: The NAEP Mathematics scale ranges from 0 to 500. * Significant at .05. ** Significant at .01.

Figure 1—Iowa NAEP Grade 4 Mathematics Results with Subscales



* Accommodations were not permitted for this assessment.
**Scale exaggerated to show differences.

Source: Iowa Department of Education, Bureau of Planning, Research, Development and Evaluation.

Similarly, Iowa's eighth-grade students perform better than the nation's eighth-grade students. However, the gap between performance of the nation's public schools and Iowa's public schools on eighth-grade mathematics has closed significantly during the last decade.

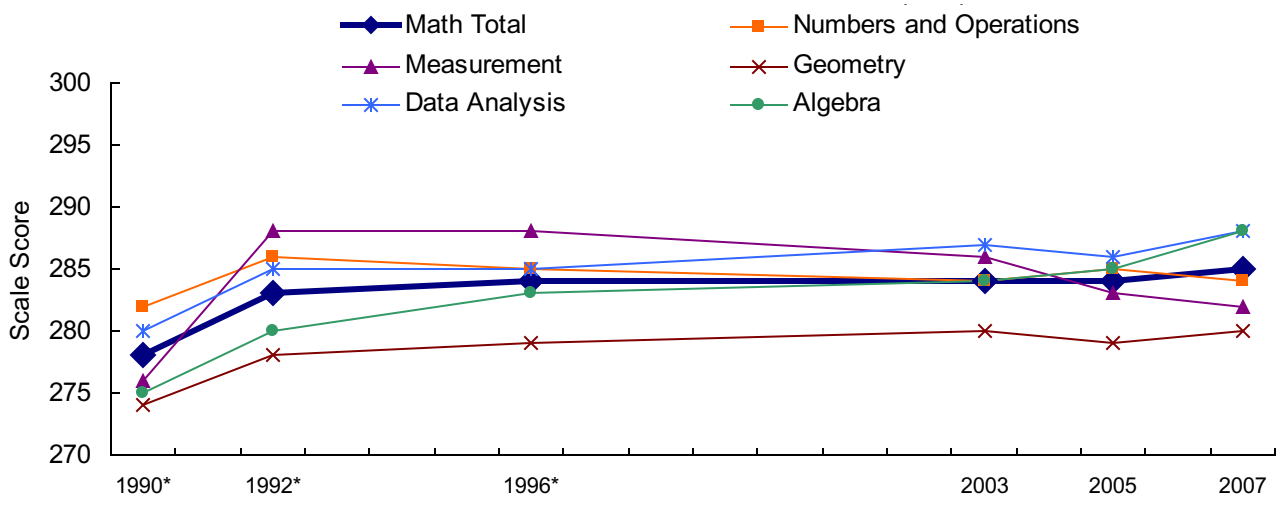
Table 2—NAEP Mathematics Subscale Scores for Iowa and the Nation Grade 8

		Math Total		Numbers and Operations		Measurement		Geometry		Data Analysis		Algebra	
Year	Jurisdiction	Scale Score	Dif (IA - US)	Scale Score	Dif (IA - US)	Scale Score	Dif (IA - US)	Scale Score	Dif (IA - US)	Scale Score	Dif (IA - US)	Scale Score	Dif (IA - US)
1990 [1]	Iowa	278		282		276		274		280		275	
	Nation	262	16**	266	16**	258	18**	256	18**	262	18**	260	15**
1992 [1]	Iowa	283		286		288		278		285		280	
	Nation	267	16**	271	15**	265	23**	262	16**	267	18**	266	14**
1996 [1]	Iowa	284		285		288		279		285		283	
	Nation	271	13**	272	13**	268	20**	268	11**	270	15**	272	11**
2003	Iowa	284		284		286		280		287		284	
	Nation	276	8**	276	8**	274	12**	274	6**	279	8**	279	5**
2005	Iowa	284		285		283		279		286		285	
	Nation	278	6**	276	9**	274	9**	275	4**	280	6**	281	4**
2007	Iowa	285		284		282		280		288		288	
	Nation	280	5**	278	6**	276	6**	277	3	283	5**	284	4**

[1]Accommodations were not permitted for this assessment.

Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1990, 1992, 1996, 2003, 2005, and 2007 Mathematics Assessments.
Note: The NAEP Mathematics scale ranges from 0 to 500. * Significant at .05. ** Significant at .01.

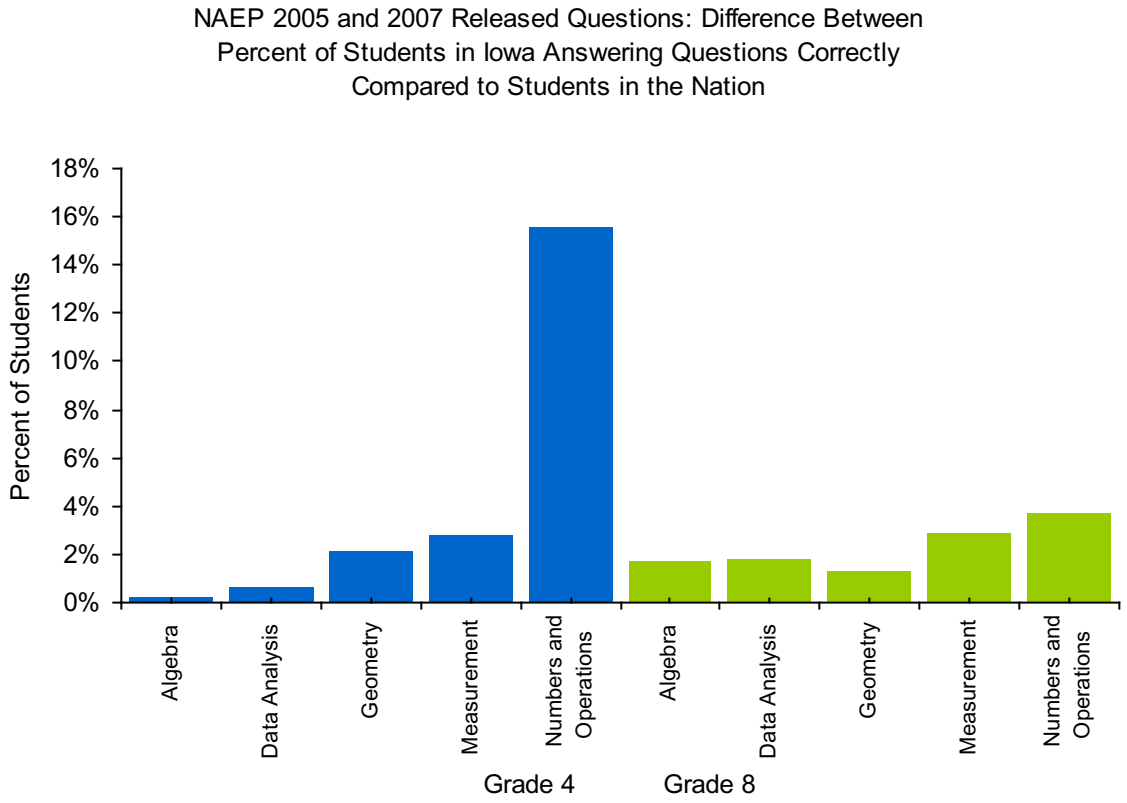
Figure 2—Iowa NAEP Grade 8 Mathematics Results with Subscales



* Accommodations were not permitted for this assessment.
**Scale exaggerated to show differences.

Source: Iowa Department of Education, Bureau of Planning, Research, Development and Evaluation.

Figure 3—Differences between Iowa and the Nation on NAEP 2005 and 2007 Mathematics Released Items



Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1990, 1992, 1996, 2000, 2003, 2005 and 2007 Mathematics Assessments.
Note: The NAEP Mathematics Algebra Functions scale ranges from 0 to 500. Observed differences are not necessarily statistically significant.

Conclusion—The NAEP released questions indicated that Iowa students in grades four and eight comprehend the Numbers and Operations subscale better than their national counterparts. However, differentiation in the other subscales is not as dramatic. Additional study comparing the results of the NAEP released items with the Iowa Tests should be considered. A comparison of Iowa districts' mathematics written and taught curriculum might also be valuable.

REFERENCES

Harris, D.N. & S. J. Adams, (2007). Understanding the level and causes of teacher turnover: A comparison with other professions. *Economics of Education Review*, 26(3), 2007: 325-337.

Ingersoll, R. (2001). *Teacher turnover, teacher shortages, and the organization of schools*. Seattle, WA, Center for the Study of Teaching and Policy, University of Washington.

APPENDIX A

Table 3—Grade 4 Mathematics Subscale Differences, Iowa and the Nation

SUBSCALE	DIFFI-CULTY	DATA: DIFFERENCE OF IA AND NATIONAL RESULTS (IOWA MINUS NATION)	2007 & 2005	1992 & 1996	CHANGE (2007 & 2005) MINUS (1996 & 1992)
Algebra	Easy	Mean difference	-0.3%	2.1%	
		Count	5	2	
	Medium	Mean difference	2.0%	6.9%	
		Count	3	4	
	Hard	Mean difference	-0.6%	4.0%	
		Count	3	4	
Algebra Mean Difference			**0.2%**	**4.8%**	**-4.5%**
Algebra Count			11	10	
Data Analysis	**Easy**	**Mean difference**	**0.1%**	**7.4%**	
		Count	4	2	
	Medium	Mean difference	1.5%	3.3%	
		Count	5	5	
	Hard	Mean difference	-1.0%	4.1%	
		Count	1	5	
Data Analysis Mean Difference			**0.7%**	**4.3%**	**-3.7%**
Data Analysis Count			10	12	
Geometry	**Easy**	**Mean difference**	**2.7%**	**5.4%**	
		Count	5	3	
	Medium	Mean difference	1.0%	6.3%	
		Count	6	3	
	Hard	Mean difference	3.8%	1.8%	
		Count	3	5	
Geometry Mean Difference			**2.2%**	**4.0%**	**-1.8%**
Geometry Count			14	11	
Measurement	**Easy**	**Mean difference**	**3.0%**	**4.8%**	
		Count	6	3	
	Medium	Mean difference	4.5%	4.8%	
		Count	6	6	
	Hard	Mean difference	-0.8%	3.1%	
		Count	3	7	
Measurement Mean Difference			**2.8%**	**4.1%**	**-1.3%**
Measurement Count			15	16	
Numbers and Operations	**Easy**	**Mean difference**	**28.7%**	**3.8%**	
		Count	19	10	
	Medium	Mean difference	0.0%	4.6%	
		Count	9	12	
	Hard	Mean difference	1.8%	3.4%	
		Count	8	13	
Numbers and Operations Mean Difference			**15.6%**	**3.9%**	**11.6$**
Numbers and Operations Count			36	35	
Grade 4 Mean Difference			**7.5%**	**4.1%**	**3.3%**
Grade 4 Count			86	84	

Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1990, 1992, 1996, 2000, 2003, 2005 and 2007 Mathematics Assessments.
Note: Observed differences are not necessarily statistically significant.

Table 4—Grade 8 Mathematics Subscale Differences, Iowa and the Nation

SUBSCALE	DIFFI-CULTY	DATA: DIFFERENCE OF IOWA AND NATIONAL RESULTS	2007 & 2005	1992 & 1996	CHANGE (2007 & 2005) MINUS (1996 & 1992)
Algebra	Easy	Mean difference	2.5%	9.4%	
		Count	10	6	
	Medium	Mean difference	1.5%	9.3%	
		Count	10	5	
	Hard	Mean difference	1.1%	6.6%	
		Count	7	4	
Algebra Mean Difference			**1.8%**	**8.6%**	**-6.8%**
Algebra Count			27	15	
Data Analysis	**Easy**	**Mean difference**	**3.2%**	**11.2%**	
		Count	7	8	
	Medium	Mean difference	2.3%		
		Count	4		
	Hard	Mean difference	-1.2%	3.5%	
		Count	4	5	
Data Analysis Mean Difference			**1.8%**	**8.2%**	**-6.4%**
Data Analysis Count			15	13	
Geometry	**Easy**	**Mean difference**	**2.9%**	**8.1%**	
		Count	8	6	
	Medium	Mean difference	0.2%	14.3%	
		Count	7	4	
	Hard	Mean difference	0.7%	6.1%	
		Count	8	6	
Geometry Mean Difference			**1.3%**	**8.9%**	**-7.6%**
Geometry Count			23	16	
Measurement	**Easy**	**Mean difference**	**2.1%**	**9.8%**	
		Count	5	9	
	Medium	Mean difference	6.9%	7.3%	
		Count	4	3	
	Hard	Mean difference	0.8%	8.6%	
		Count	6	10	
Measurement Mean Difference			**2.9%**	**8.9%**	**-6.0%**
Measurement Count			15	22	
Numbers and Operations	**Easy**	**Mean difference**	**4.6%**	**7.8%**	
		Count	13	18	
	Medium	Mean difference	3.2%	-2.6%	
		Count	10	6	
	Hard	Mean difference	2.7%	6.6%	
		Count	6	8	
Numbers & Operations Mean Difference			**3.7%**	**5.5%**	**-1.8%**
Numbers and Operations Count			29	32	
Grade 8 Mean Difference			**2.3%**	**7.7%**	**-5.3%**
Grade 8 Count			109	98	
Grades 4 & 8 Total Mean Difference			**4.6%**	**6.0%**	**-1.4%**
Grades 4 and 8 Total Count			195	182	

Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1990, 1992, 1996, 2000, 2003, 2005 and 2007 Mathematics Assessments.
Note: Observed differences are not necessarily statistically significant.

APPENDIX B

Relationship of Subscale to Total Assessment

The percent of each subscale in the total assessment has changed only slightly from 1992 to 2007.

Table 5—Percentage Distribution of Items by Grade, Year, and Content Area

	GRADE 4 (%)					GRADE 8 (%)				
	1992	1996	2003 (NO CHANGE)	2005	2007 (NO CHANGE)	1992	1996	2003 (NO CHANGE)	2005	2007 (NO CHANGE)
Numbers and Operations	45	40/70	40/70	40	40	30	25/60	25/60	20	20
Measurement	**20**	**20**	**20**	**20**	**20**	**15**	**15**	**15**	**15**	**15**
Geometry	15	15	15	15	15	20	20	20	20	20
Data Analysis	**10**	**10**	**10**	**10**	**10**	**15**	**15**	**15**	**15**	**15**
Algebra	10	15	15	15	15	20	25	25	30	30

Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1990, 1992, 1996, 2000, 2003, 2005 and 2007 Mathematics Assessments.