



Arizona Mathematics Content Standard to NAEP Mathematics Framework



Alignment Study

*Executive Summary
June 2007*

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Introduction

The current Arizona Mathematics Standard was articulated by grade level in 2003 by Arizona educators with guidance from the Arizona Department of Education in order to meet federal guidelines. The previous Standard was written in grade-level clusters and had benchmarks at Grades 3, 5, 8, and high school. The standard is set to be revisited in 2007-2008 to fulfill the schedule for periodic review.

While working within the requirements of NCLB, Arizona schools have also participated in the National Assessment of Educational Progress (NAEP) since the early 1990's. The NAEP is used to measure student performance and how that performance changes over time across the nation and state-by-state. Under the No Child Left Behind Act (2001) legislation, schools across the nation accepting Title I funds are required to participate in the NAEP. The Arizona Board of Education has taken the participation a step further by deeming the NAEP a necessary national assessment for all Arizona schools to participate in if selected. Although there are no awards or penalties tied to NAEP performance, every state is able to see the trend of their students' progression over time in key content areas such as mathematics and reading.

The National Assessment Governing Board, whose purpose is to set policy for the NAEP, called for the development of a new mathematics framework in the early 2000's. In 2005, the new mathematics framework became operational for the National and State NAEP.

On the cusp of the Arizona Mathematics Standard revision, Arizona’s Superintendent of Public Instruction, Tom Horne, requested an alignment study comparing the NAEP Mathematics Framework for grades 4 and 8 to the current Arizona mathematics content standards for grades 1-8. The research questions for this study are:

- 1) Which NAEP Mathematics Framework objectives are exact matches, partial matches, or not covered by the Arizona Mathematics Standard Performance Objectives?
- 2) In which grade(s) are the NAEP Mathematics Framework objectives taught in the Arizona Mathematics Standard?

The purpose of this study is to provide the Arizona Standards Revision Committee with a report on the alignment of the current Arizona mathematics content standard to the NAEP mathematics framework with the goal of producing a fully aligned revision. The alignment committee met for three days, June 11-13, 2007 at the Black Canyon Conference Center in Phoenix, Arizona to complete the study. The preliminary results for the upper grades were presented to the Arizona Standards Revision Committee on June 27, 2007. The Revision committee’s focus for the June meeting was on the upper grades.

Methodology

Researching current national alignment models revealed that there wasn’t a model that only compared standards to standards in the detail we needed for the Revision Committee so a new one was devised. Participants compared the content of the NAEP Framework objectives for grades 4 and 8 to the Arizona Mathematics Content Standards for grades 1 through 8. Two groups were formulated (six participants in the Elementary Group

and seven participants in the Intermediate Group) to examine grade spans 1 through 4 and 5 through 8 (See Appendix A). The committee members were required to be proficient with the Arizona Mathematics Standard based on their teaching experience.

Interrater Agreement

An interrater agreement assessment was given to the groups to confirm that all participants understand the process of rating the contents and to see how much agreement could be expect on average from our groups. Three NAEP objectives were used for each group during this session. The groups were given 20 minutes to decide if there were “exact match,” “partial match,” or “no matches” in the Arizona performance objectives. The group also had the option of marking the “unsure” column and adding comments. This task was completed individually followed by a second task of a group discussion regarding their ratings of the three objectives. The Elementary Group had 86.7 percent complete agreement with each other and the Intermediate Group had 76.2 percent complete agreement. This was found acceptable after reviewing their worksheets in detail. (See Appendix C for a detailed description.) There was a scribe assigned to each group to provide a transcript of the discussions for the final report.

Alignment Model

There were two packets of worksheets for the committees to work through. The first worksheet (see Appendix D for an example of Worksheet #1) had a NAEP objective listed at the top and contained a table with four columns marked “exact match,” “partial match,” “unsure,” and “comments.” The participants were asked to, first, work alone to list the Arizona performance objectives they felt fell into these categories. Next, they discussed their individual results within their group. After discussion, participants were permitted to change

their selections. The Elementary Group had 65 NAEP objectives to work through and the Intermediate Group had 101 NAEP objectives to cross-check.

The second set of worksheets (known as Worksheet #2) had the Arizona Mathematics Performance Objectives listed down the side with five columns titled “included,” “partial included,” “unsure,” “not included at all,” and “comments”¹ (see Appendix E for an example of Worksheet #2). Worksheet #2 required that the participants work individually. This worksheet provided a different perspective of alignment between the Arizona Standard and the NAEP Framework. The purpose of this worksheet was to reveal the detailed information we needed to tell what may be missing from the Arizona Standards.

After the Elementary Group completed the second worksheet they were debriefed about the process. Six raters completed Worksheet #2 for the Elementary Group. The debriefing revealed a few issues with Worksheet #2 that were able to be adjusted prior to the second group using it. A few adjustments were made prior to the Intermediate Group working on Worksheet #2. Those adjustments are as follows:

- 1) A training was incorporated for the second group to clarify how to use Worksheet #2.
- 2) In order to complete the study within the time limits of the workshop, we had to break the second group up into three groups to complete the second worksheet. We found that based Elementary group’s results from worksheet #2 that it wasn’t necessary to have as high as six raters work on the entire list of objectives. We had three groups of three raters working individually on sections of the Arizona performance objectives. The last two hours of the workshop one group had only two raters for the last three sections. Their experience, proficiency with the Arizona

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Mathematics Standard, and their familiarity with the NAEP Framework after working on Worksheet #1 gave us the confidence to allow this group to proceed with fewer raters.

During the three-day study, we had a scribe assigned to each group to record any comments that participants made pertaining to the Arizona standards/performance objectives, NAEP framework/objectives, or the alignment model. On the third day the participants handed in an evaluation sheet regarding the alignment model we were piloting with this study.

Results

The data review and the participant comments indicated that the NAEP mathematics objectives were broader than the Arizona mathematics performance objectives. This caused frustration among the raters when it came to looking for exact matches on Worksheet #1. As a result, the raters listed a number of Arizona performance objectives under any one NAEP objective that would create a full or partial match. Both worksheets were combined to show if there were matches between the NAEP and Arizona and exactly what performance objectives made up those matches and what grade spans these elements were being taught at in order to answer both research questions. The combination of the two worksheets revealed another element that we were not expecting to see. We were able to determine which elements were missing from the Arizona Mathematics Standard to complete a “full match.” It should be noted that there were “full” matches, “partial” matches, and “no” matches found along with a list of Arizona Mathematics Standards that are not covered by NAEP.

The Tables 1 through 4 read left to right; however, you may see a number of Arizona Performance Objectives listed for one NAEP Objective. This is the result of the difference in breadth of the NAEP Objectives versus the Arizona Performance Objectives. For example:

Strand	Concept	NAEP Code	AZ Grade Span	Inclusion of AZ POs under the NAEP Objective	Exact, Partial, Weak, and No Matches between the NAEP Mathematics Framework Objectives and the Arizona Mathematics Standard Performance Objectives
				Percentage of Rater Agreement	
				Rater Agreement 0% 25% 50% 75% 100% Completely Included Partially Included Unsure Weak coverage	Red - This NAEP objective is missing in Arizona Standard Blue - This NAEP objective is completely covered in Arizona Standard Lt. Blue - This NAEP objective is partially covered in Arizona Standard Yellow - Very weak coverage of NAEP objective in Arizona Standard
30	Measuring Physical Attributes	M8-M-C1-g Select or use appropriate measurement instrument to	5-7	G5-S4C4-02 G6-S4C4-04 G6-S4C4-02 G6-S4C4-02	Mass and weight not included in AZ (6). Volume is missing (2).

This NAEP objective is *Measurement* and the content strand is *Measuring Physical Attributes*. Our raters found that there was only a partial match of the objective (as seen by

the blue indication of the last column) to the Arizona Standard in grade span 5-7. The Arizona performance objectives that make up that partial match are listed in column three, G5-S4C4-02, G6-S4C4-04, and G6-S4C4-02. Of the raters, 67% of the raters felt that G5-S4C4-02 and G6-S4C4-04 were completely included in the NAEP objective, 33% of the raters felt that G6-S4C4-02 was completely included, and 33% felt that G6-S4C4-02 was partially included. Combining the Arizona performance objectives does not form a full match to the NAEP objective, meaning that there are still elements left out of the Arizona Mathematics Standard that are being tested on NAEP.

Grade 4

The committee found 20 NAEP objectives or nearly 31% (shown in red), that are not covered in the current Arizona Mathematics Standard. When combined with those NAEP objectives that are “weakly” covered (11%) by the Arizona Mathematics Standard, 42% of the NAEP Framework is not covered by Arizona teachers. (The term “weakly” in this context refers to the fact that the participants believed one aspect of the NAEP objective might be covered, but not enough to be considered partial coverage). For example, the NAEP Objective in Measurement/Systems of Measurement, M4-M-C2-e, “*Determine situations in which a highly accurate measurement is important.*” was found by the raters not to have been covered at all in the Arizona Mathematics Standard. In fact, it was noted by one rater that this NAEP objective would be “a great AZ PO.”

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				Rater Agreement 0% 33% 60% 75% 100% Completely Included Partially Included Unsure Weak coverage	Red - This NAEP objective is missing in Arizona Standard Blue = This NAEP objective is completely covered in Arizona Standard Lt. Blue- This NAEP objective is partially covered in Arizona Standard Yellow - Very weak coverage of NAEP objective in Arizona Standard
20	Properties of Number & Operations	M4 - N - C5 - f Explain or justify a mathematical concept or relationship (e.g., explain why 15 is an odd number or why 7-3 is not the same as 3-7).	3	G3-S1C2-13 G3-S1C2-12	No matches (5). No match but a great idea for AZ. No explain or justify in AZ standards (2), could be Strand 5 for next time around.

Example 1

In the table above (Example 1), the NAEP Objective shown above in *Number Properties and Operations/Properties of Number & Operations*, M4-N-C5-f, was designated as “weakly” covered by our raters. One half of the raters felt that the Arizona performance objective, G3-S1C2-13, was fully covered (hence, the blue color of the bar in Table 2 of the final report). Only one-third of the raters felt that Arizona performance objective, G3-S1C2-12, was partially covered by this NAEP objective.

Many of the NAEP objectives are partially covered (40%) which means that although there are some Arizona performance objectives included under a particular NAEP objective, there are still missing elements. In some cases, the NAEP objectives for grade 4 aren’t covered until later grades, thus marked as “partially” covered.

For example:

Strand	Concept	NAEP Code	AZ Grade Span	Inclusion of AZ POs under the NAEP Objective	Exact, Partial, Weak, and No Matches between the NAEP Mathematics Framework Objectives and the Arizona Mathematics Standard Performance Objectives
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50	Characteristics of Data Sets	M4 - D - C2 - d Compare two sets of related data.	2-5	G2-S2C2-06 G3-S2C2-06 G4-S2C2-07	The exact match is at 5th Grade, G5-S2C1-07

Example 2

The NAEP objective shown above (Example 2), *Data Analysis and Probability/Characteristics of Data Sets*, M4-D-C2-d, was designated as a partial match (shown in light blue color) because, although, the raters listed three Arizona performance objectives that are fully covered, they felt it is not an exact match to the NAEP objective until Grade 5.

There are 12 NAEP objectives out of 65 (18%) that are considered fully matched with Arizona performance standards as shown in Table 2 of the final report. Some of the discrepancy found between a partial match and an exact match was the breadth of the NAEP objectives. Many of the Arizona performance objectives may be fully covered under one NAEP objective, however, due to the breadth of the NAEP objective there may have been one or two elements left uncovered by the Arizona Mathematics Standard; thereby, qualifying it a partial match.

Grade 8

The committee found 21 NAEP objectives or nearly 21% (shown in red), that are not covered in the current Arizona Mathematics Standard, such as:

- M8-N-C3-d Describe the effect of multiplying and dividing by numbers including the effect of multiplying or dividing a rational number by:
- zero, or
 - a number less than zero, or
 - a number between zero and one,
 - one, or
 - a number greater than one.

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There are 15 additional NAEP objectives that are “weakly” covered, which is nearly 15%. Combined with the NAEP objectives that are not covered; this equals 36% of the NAEP Mathematics Framework that is not being covered in our Arizona Schools.

Strand	Concept	NAEP Code	AZ Grade Span	Inclusion of AZ POS under the NAEP Objective	Exact, Partial, Weak, and No Matches between the NAEP Mathematics Framework Objectives and the Arizona Mathematics Standard Performance Objectives
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				Rater Agreement 0% 25% 50% 75% 100% Completely Included Partially Included Unsure Weak coverage	Red - This NAEP objective is missing in Arizona Standard Blue - This NAEP objective is completely covered in Arizona Standard Lt. Blue- This NAEP objective is partially covered in Arizona Standard Yellow - Very weak coverage of NAEP objective in Arizona Standard
74	Experiments and Samples	M8-D-C3-d Evaluate the design of an experiment.	7	Weak coverage	Students do not design an experiment. "Evaluate" not in standards.

Example 3

For example, the NAEP objective for *Data Analysis and Probability/Experiments and Samples*, M8-D-C3-d, was noted by the raters as missing in the Arizona standards, “Evaluate [is] not in the standards.”

There are 58 NAEP objectives (57%) that are partially covered by Arizona performance objectives (shown in Table 3 of the final report) and 13 NAEP objectives (13%) that are completely covered (shown in blue in the last column of Table 4 of the final report) by the Arizona performance objectives.

Conclusion

The NAEP framework, as a whole, was specifically written to assess every objective; therefore, if we find that Arizona standards are not covering an area in the NAEP framework, the chances of our students scoring higher on that portion of the NAEP are extremely slim.

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The raters felt at times there was a language barrier between the NAEP framework and the Arizona Standard; for example, the word “attributes” versus “properties” in the *Number Properties and Operations* strand was discussed for quite some time regarding the actual definition of both words and whether the interpretation meant the same for both.

When studying the list of NAEP objectives that are only partially covered by Arizona performance objectives (indicated by light blue in column 6 of Tables 1 and 3 of the final report), math experts will be able to tell by omission in column 5 (“Percentage of Rater Agreement – Inclusion of AZ POs under the broader NAEP Objective”), the elements missing from the Arizona Mathematics Standard that are being tested on NAEP Mathematics. In the early grades, many of the NAEP Grade 4 objectives aren’t covered until Grade 5 or later in Arizona thus listed as “partially” covered by Arizona performance objectives in Tables 1 and 3 of the final report. A total of 42% of NAEP objectives at Grade 4 and 36% of NAEP objectives at Grade 8 are not included in the Arizona Mathematics Standard being taught by teachers in our schools. This is only one piece of the puzzle to form an alignment with NAEP. Addressing the results of this study should make some impact in the students’ performance on the state NAEP.

Footnotes

1. Worksheet #2 initially had “Exact match,” “Partial match,” “Unsure,” “No Match,” and “Comments” as column heads until the first group (i.e., elementary group) to work on the form had trouble with those terms. The NAEP objectives were much broader than the Arizona performance objectives. During a debriefing with the elementary group, after they completed worksheet, a decision was made to replace the terms “Exact match,” “Partial match” and “No Match” with “Included,” “Partially Included,” and “Not Included at All.” There was enough time to make these changes to the form before the second group (i.e. Intermediate Group) was ready for Worksheet #2.

References

- Murphy, K. R., DeShon, R. (2000). Interrater correlations do not estimate the reliability of job performance ratings. *Personnel Psychology*, 53, 873-900.
- Tziner, A., Murphy, K., Cleveland, J., Beaudin, G., Marchand, S. (1998) Impact of rater beliefs regarding performance appraisal and its organizational contexts on appraisal quality. *Journal of Business and Psychology*, 12, 457-467.

**Note: All tables and appendices will be distributed upon request. Please call the Arizona Department of Education, Standards and Assessment Section for any requests regarding this report at 602-542-5031.*