

## **NAEP 12<sup>th</sup> Grade Preparedness Research: Analyses Relating Florida Students' Performance on NAEP to Preparedness Indicators and Postsecondary Performance**

*Rebecca Moran, David Freund, and Andreas Oranje, ETS*

As part of the National Assessment Governing Board's efforts to enable NAEP to report on the preparedness of U.S. twelfth graders for postsecondary education or entry into job training programs, various studies were conducted to statistically relate performance on NAEP with results from other assessments that serve as indicators of preparedness for college entry, course placement, and entry into the workforce (National Assessment Governing Board, 2009). Both nationally-representative data, such as those used to establish a statistical link between NAEP and SAT, and data representative of students in individual states were of interest for such statistical relationship studies. The 2009 12<sup>th</sup> grade NAEP reading and mathematics assessments included a first-time pilot state assessment for 11 states; Florida was one of the participants. The Florida Department of Education (DOE) maintains a longitudinal data base (K-20 Education Data Warehouse) that includes college entrance and placement test scores and first-year college performance data for those students who attended public colleges in the state of Florida during the 2009-2010 academic year. Therefore, this Florida longitudinal data could provide information about postsecondary outcomes for many of the students who also participated in 12<sup>th</sup> grade NAEP.

This document describes the data and procedures used to evaluate Florida students' performance in high school and first year of college relative to scores on the NAEP 12<sup>th</sup> grade reading and mathematics assessments and other test scores. This will be followed by a description of the analyses that serve as a follow-up to the statistical relationships established between NAEP and SAT at the national level. Of particular note are the analyses of postsecondary data to provide validity evidence for the potential preparedness reference points on the NAEP scales identified in the national statistical relationship studies.

### **Data**

This study used data from Florida public school students who participated in the 2009 NAEP 12<sup>th</sup> grade reading or mathematics assessments, approximately 3,200 in math and 3,400 in reading. Analyses were conducted with the use of NAEP sampling weights to appropriately represent 12<sup>th</sup> grade public school students in Florida in 2009.

#### **Matching NAEP and Florida DOE Data**

The Governing Board entered into an agreement with the Florida DOE to obtain longitudinal data for public school students selected to participate in the 2009 NAEP 12<sup>th</sup> grade assessment. The process of matching data between the Florida database and NAEP participants was carried out in coordination with NAEP contractors, Westat and ETS, and the Florida DOE.

A critical requirement of the matching of student records was to protect students' identity and maintain confidentiality. This was assured through the assignment of a unique pseudo ID for students sampled to participate in NAEP. At the time of sample selection of students for operational NAEP, Florida DOE staff appended the pseudo ID to files within the Florida DOE and transmitted the pseudo ID to Westat with other administration data. On all subsequent data files containing Florida data (e.g., ACT scores), only the pseudo ID was included on the files. The pseudo ID was used by Westat to match files from Florida back to the NAEP data

files. Westat in turn provided files to ETS with the additional Florida data appended to NAEP student records. Throughout the process, ETS had no access to any Personally Identifiable Information (PII), such as names, birthdates, or social security numbers. This process was essentially identical to the matching process employed for the NAEP-SAT national linking study.

#### Data Elements evaluated for use in the Florida Preparedness Research

Of the variables available in the extensive Florida longitudinal dataset for the 2009 12<sup>th</sup> grade cohort, those examined for use in this research are described briefly below. Some of these data elements lacked sufficient power (i.e., small sample sizes in the linked set) and, therefore, are of limited value for extensive use in the current research.

1. **Florida Comprehensive Assessment Test (FCAT)** is Florida's K-12 state assessment. Scores on the reading and mathematics tests from 3<sup>rd</sup> through 10<sup>th</sup> grades were available in the longitudinal dataset. Match rates were very high, with 10<sup>th</sup> grade scores in reading and math matched to approximately 94% of the NAEP test takers. However, concerns about the relevance of relating students' 12<sup>th</sup> grade NAEP performance to FCAT scores earned two years earlier, while in 10<sup>th</sup> grade, precluded further analyses being pursued with the FCAT data.
2. **WorkKeys** is a job skills assessment system that helps employers select, hire, train, develop, and retain a high-performance workforce. WorkKeys includes three relevant tests: Applied Mathematics, Locating information, and Reading for Information. Matched samples contained about 300 students (about 10% of the NAEP sample in each subject) for each WorkKeys test and, therefore, were inadequate for further analysis.
3. **Advanced Placement (AP)** college-level exams enable students to earn college credit and advanced placement in college courses. Approximately 36% of students in the NAEP samples took one or more AP tests. However, only 16% of the NAEP reading sample took a relevant reading AP exam (English or English Literature) and only 8% of the NAEP mathematics sample took a relevant math AP exam (calculus). The small sample sizes limited the efficacy of these data for further analysis.
4. **High School Program:** One of the background questions asked of students on the 12<sup>th</sup> grade NAEP assessment was, "Which of the following best describes your high school program?" Response options included (1) General, (2) Academic or college preparatory, and (3) Vocational or technical school. For the NAEP Florida sample, approximately 47% of students indicate their program was "general," 43% indicated "academic or college preparatory," and 9% indicated "vocational or technical school." These data were examined in much greater detail and will be discussed in this memorandum.
5. **SAT and ACT College Entry Exams and ACCUPLACER College Placement Exam.** Approximately 43% of Florida's NAEP sample took the SAT test; 47% took the ACT test, and 18% took the ACCUPLACER test. The match rates for SAT and ACT are relatively close to Florida SAT- and ACT test-taking rates and, therefore, the match was successful. This data is informative for NAEP preparedness research to the extent that College Board and ACT have developed preparedness benchmarks for their respective assessments.
6. **College Enrollment Status, First-Year Course-taking and Grade-point Average:** Data were available for students attending public colleges and universities in Florida for the 2009-2010 academic year. Approximately 54% of the students in Florida's 2009 NAEP 12<sup>th</sup> grade sample attended a public postsecondary institution in Florida, with 36% attending community colleges and 17% attending four-year colleges and universities.

## Analyses Conducted

As mentioned above, the purpose of this research activity was to explore the relationships between Florida students' performance on the 12<sup>th</sup> grade NAEP assessments and various indicators of postsecondary preparedness to provide validity evidence for the potential preparedness reference points on the NAEP scales. These points were earlier identified by the national NAEP-SAT statistical relationship study. Table 1 provides potential reference points:

**Table 1: Potential preparedness reference points based on NAEP-SAT statistical relationship study**

<b><u>Statistical Projection</u></b>		
<b>Percentage at or above 500 on SAT</b>	<b>Math</b>	<b>Reading</b>
<b>50%</b>	164	302
<b>67%</b>	169	313
<b>80%</b>	175	325
<b><u>Concordance</u></b>		
<b>SAT Subscore = 500</b>	165	303
<b><u>NAEP "Proficient"</u></b>		
	174	302

Thus, NAEP results were examined in relation to:

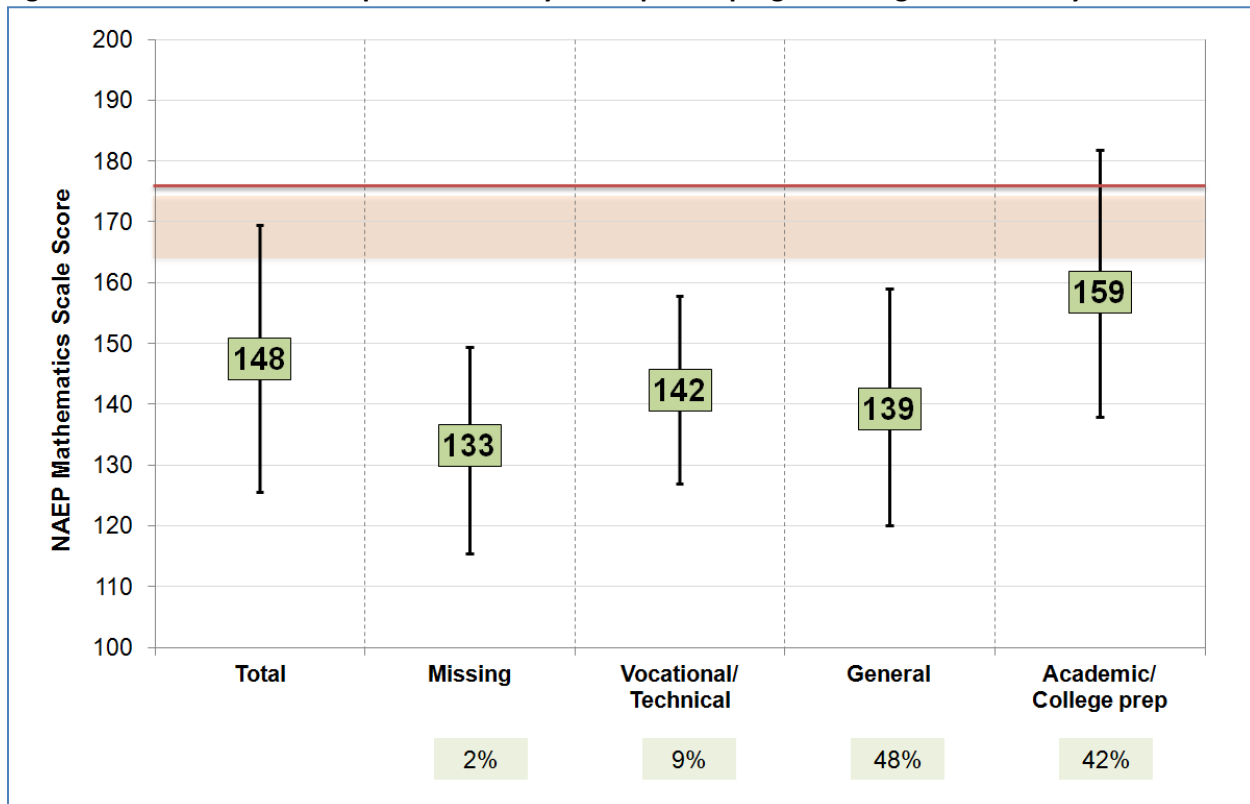
1. SAT performance, defined in terms of whether students met the SAT college readiness benchmark in each subject area (determined by College Board to be a score of 500 on the SAT critical reading and mathematics measures)
2. ACT performance; the benchmarks for college readiness established by ACT are 22 for math and 21 for reading
3. ACCUPLACER performance, where the cut scores used in Florida for placement into credit-bearing courses are 72 for math and 83 for reading
4. Students' self-reported program of study in high school, whether vocational/technical, general, or academic/college preparatory. This information was collected as part of the NAEP student background questionnaire.
5. College enrollment: community college, four-year college/university, or unknown
6. First-year college course-taking: remedial or credit-bearing
7. First-year college grade point average: above or below a B-

## Summary of Results

Relationships of NAEP reading and math performance with each of the seven indicators are provided in graphical form. Overall, the patterns of results observed for this cohort of Florida students did not contradict the potential preparedness reference points on the NAEP reading and mathematics scales identified through the national NAEP-SAT linking study.

Figure 1, which depicts the relationship between students' self-reported program of study in high school and performance on the NAEP 12<sup>th</sup> grade mathematics assessment, is used as an example to familiarize the reader with the figures. These results will be discussed in more detail later on.

**Figure 1: NAEP mathematics performance by self-reported program of high school study**



### Interpretation of Figures

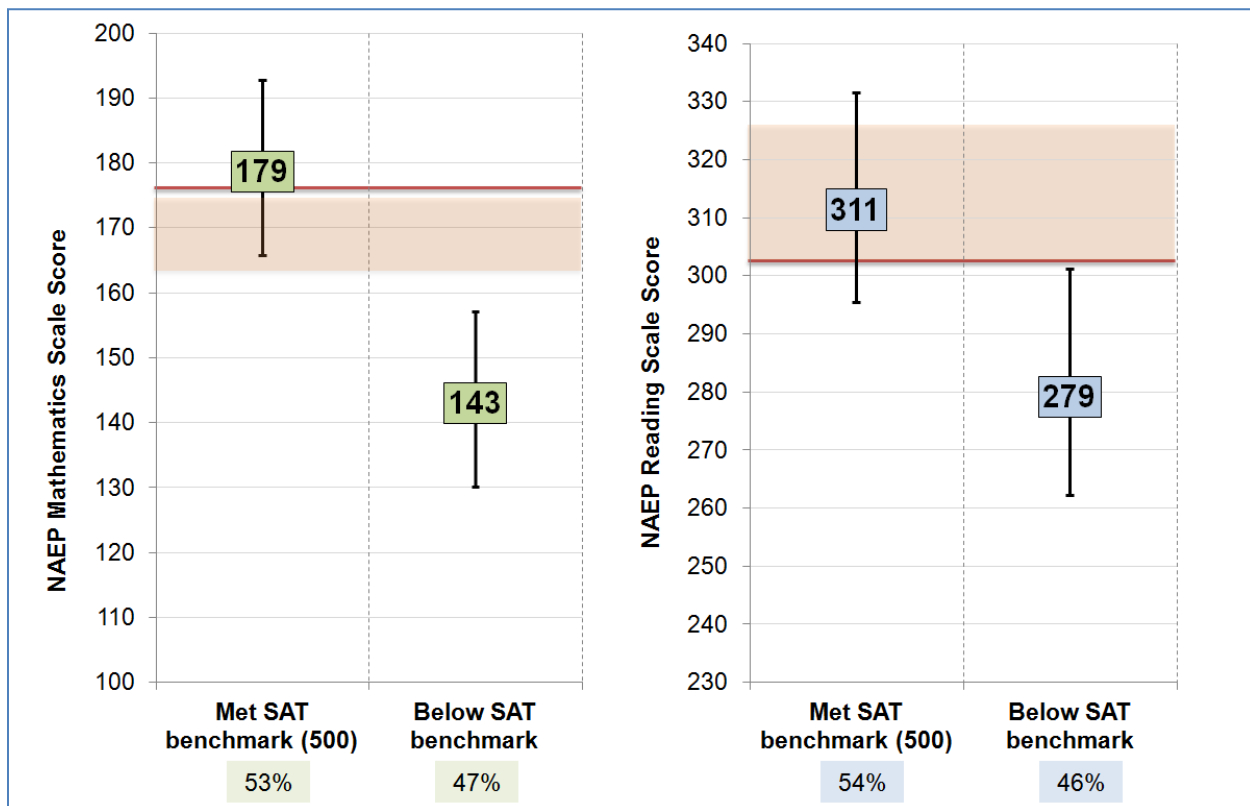
- The vertical or y-axis represents the NAEP scale score distribution and is about 3 standard deviations (SD) in range to cover all results in this study while maintaining scale consistency across graphs. In other words, the mathematics SD is about 34 so the range of the y-axis is 100 points (100-200). The reading SD is slightly higher (37) and the range in the figures is 110 points (230-340).
- The number in each box is the average scale score for the designated group of students; the endpoints of lines above and below the box indicate the 75<sup>th</sup> and 25<sup>th</sup> percentiles of the score distribution, spanning the interquartile range (IQR). For example, the rightmost category (the mathematics score distribution for students in academic/college prep high school programs of study) shows that the average score is 159, the 25<sup>th</sup> percentile is about 138, and the 75<sup>th</sup> percentile is about 182, bringing the IQR to 44.

- The dark red horizontal line represents the NAEP *Proficient* cut-point, which is 174 for 12<sup>th</sup> grade mathematics.
- The light red shaded area covers the potential “preparedness” reference points obtained from the national NAEP-SAT linking analysis. The range for math is 164-175, as also presented in Table 1.
- The horizontal or x-axis includes each of the categories for the variable/measure; the percentage in the box below the category description indicates the estimated percentage of students in that category.

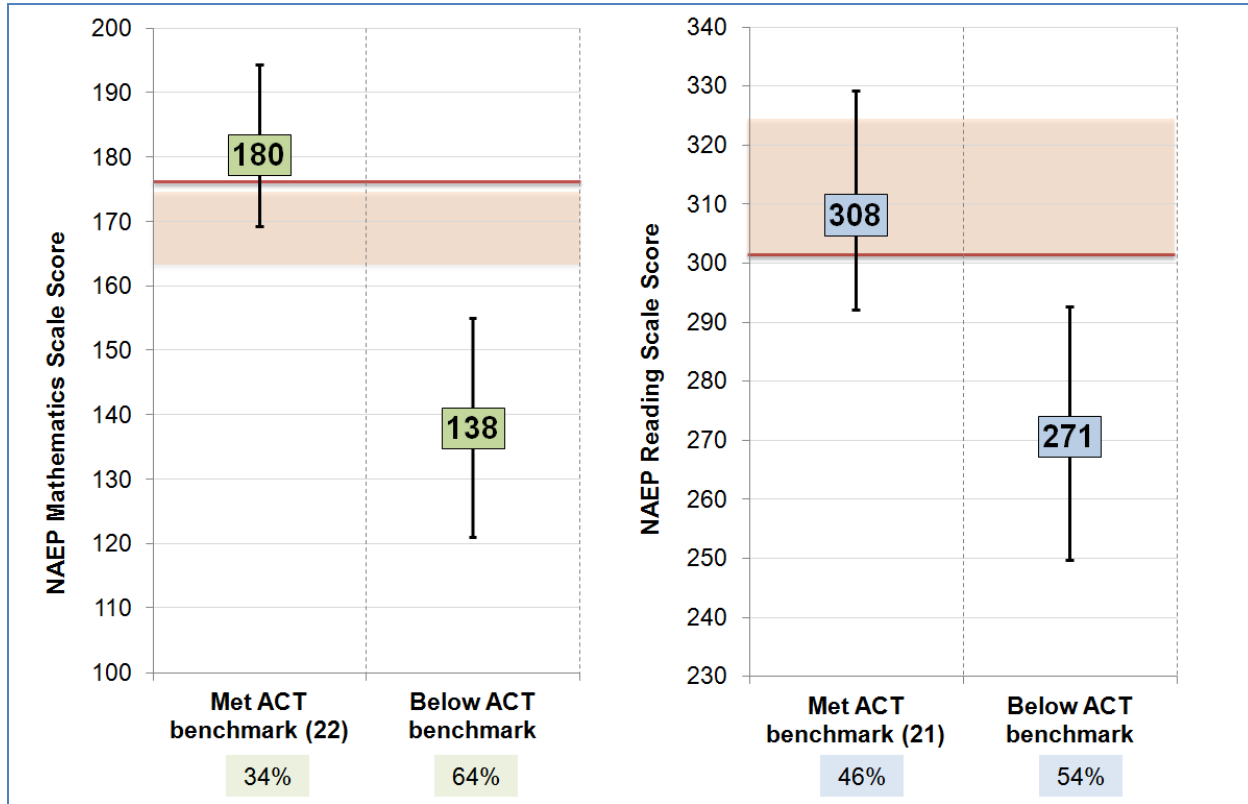
### Specific Results

Figure 2 shows the relationship of NAEP with SAT. College Board has identified a score of 500 on the SAT critical reading and mathematics measures as college readiness benchmark scores (Wyatt, Kobin, Wiley, Camara, & Proestler, 2011). Based on this SAT benchmark, 53% of Florida’s 12<sup>th</sup> graders were deemed college ready for mathematics and 54% were for critical reading. Average NAEP scores for students who met the SAT preparedness benchmarks were near the NAEP *Proficient* cut scores and fell in or above the range of possible NAEP preparedness reference points. The average scores for these students were roughly one standard deviation higher than average NAEP scores for their peers who did not meet the SAT preparedness benchmark. In addition, the IQRs for these two groups were non-overlapping for mathematics and only marginally so for reading.

**Figure 2: NAEP performance by attainment of SAT college readiness benchmarks for mathematics and critical reading**



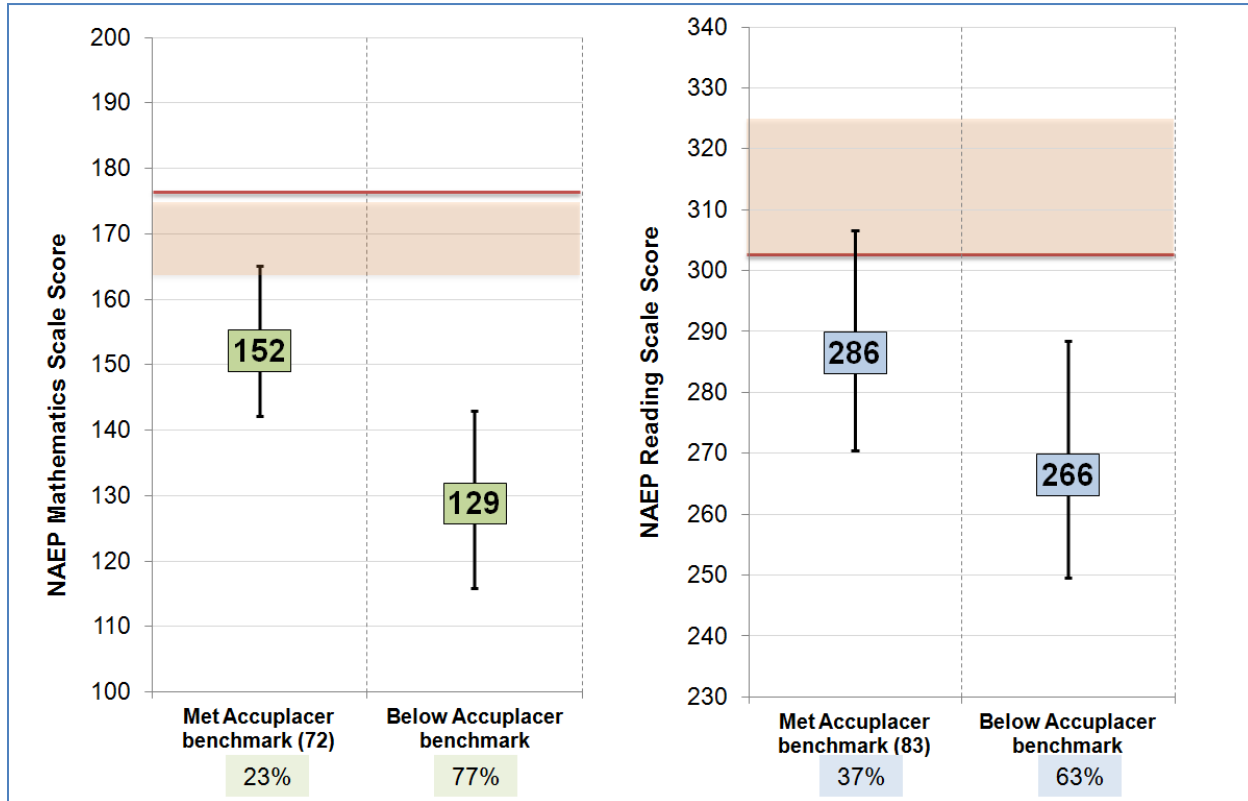
**Figure 3: NAEP performance by attainment of ACT college readiness benchmarks for mathematics and reading**



Similar to College Board, ACT has also established benchmarks for college readiness, which are an ACT score of 22 for mathematics and 21 for reading (ACT, 2010). Based on these benchmarks, Figure 3 indicates that 34% of Florida's 12<sup>th</sup> graders were college-ready for mathematics and 46% were college-ready in critical reading. Average NAEP scores for students who met the ACT readiness benchmarks were near the NAEP *Proficient* cut scores and fell in or above the range of possible NAEP preparedness reference points. The average scores for these students were roughly one standard deviation higher than average NAEP scores for their peers who did not meet the ACT readiness benchmark. Similar to SAT results, IQRs for these groups were non- or marginally overlapping.

Figure 4 provides the relationship of NAEP with ACCUPLACER performance. For ACCUPLACER cut scores used in Florida for placement into credit-bearing courses are 72 for mathematics and 83 for reading. As is shown in the figure, 23% of Florida 12<sup>th</sup> graders who took ACCUPLACER achieved the benchmark in mathematics and 37% met the reading benchmark. The figure also shows that the placement cut scores do not align as well with the potential NAEP preparedness cut points from Table 1. This could be due to a weak relation between ACCUPLACER and NAEP, different standards and purposes, or a combination of both. However, the results certainly do not disconfirm the reasonableness of those preparedness cutpoints. In addition, it is important to note that ACCUPLACER results were available for only 18% of the students in the matched NAEP- Florida sample. Students in Florida may use ACT or SAT scores to qualify for entry into credit-bearing courses as alternatives to taking ACCUPLACER. Appendix A provides a more detailed treatment of matched sample sizes across the various indicators.

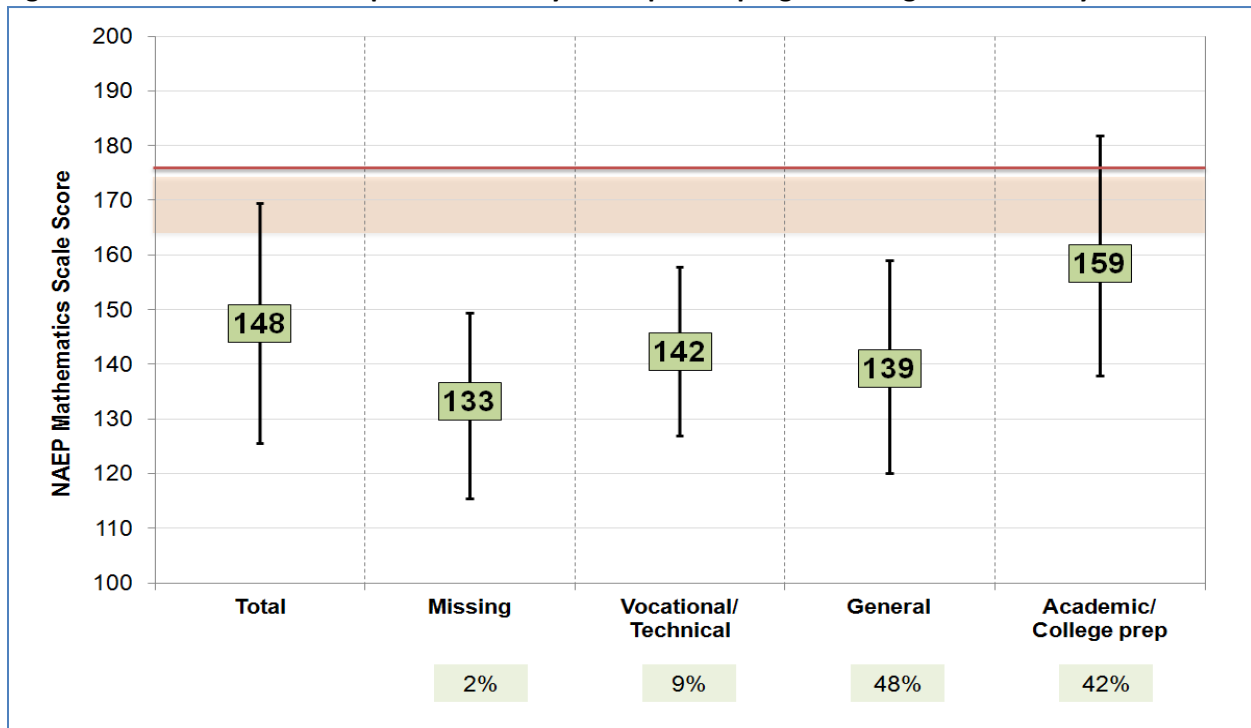
**Figure 4: NAEP performance by attainment of ACCUPLACER benchmarks for mathematics and reading**



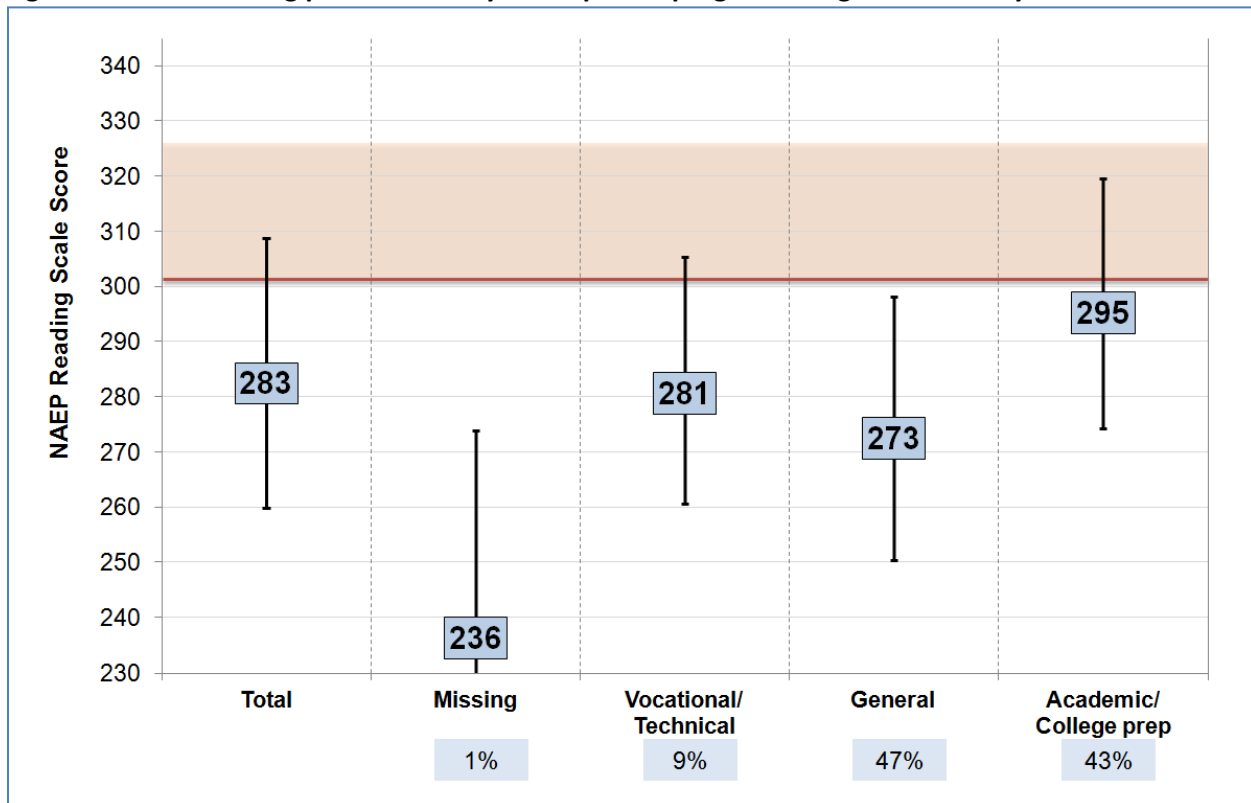
Figures 5a and 5b show the relationship between self-reported high school program of study and NAEP mathematics and reading performance, respectively. Of the Florida 12<sup>th</sup> graders in the NAEP mathematics sample, 42% indicated they were in academic/college prep curricula during high school. The average NAEP scale score for those students is 159. The 25<sup>th</sup> percentile estimate is 138; the 75<sup>th</sup> percentile is 182. Of the 42% of students in academic/college prep programs, about 31% were at or above the NAEP *Proficient* cut-point. Taking the range of potential preparedness reference points into consideration, the percent “prepared” ranged from about 31% to 45%.

In the NAEP reading sample, 43% indicated they were in academic/college prep curricula during high school. Based on the NAEP *Proficient* cutpoint, about 46% of Florida’s 12<sup>th</sup> graders in academic/college prep curriculums would be considered prepared for college in critical reading. The percent prepared is lower for students in both general programs and vocational/technical programs, although the relationship with NAEP is not as strong as for some of the other measures discussed earlier.

**Figure 5a: NAEP mathematics performance by self-reported program of high school study**

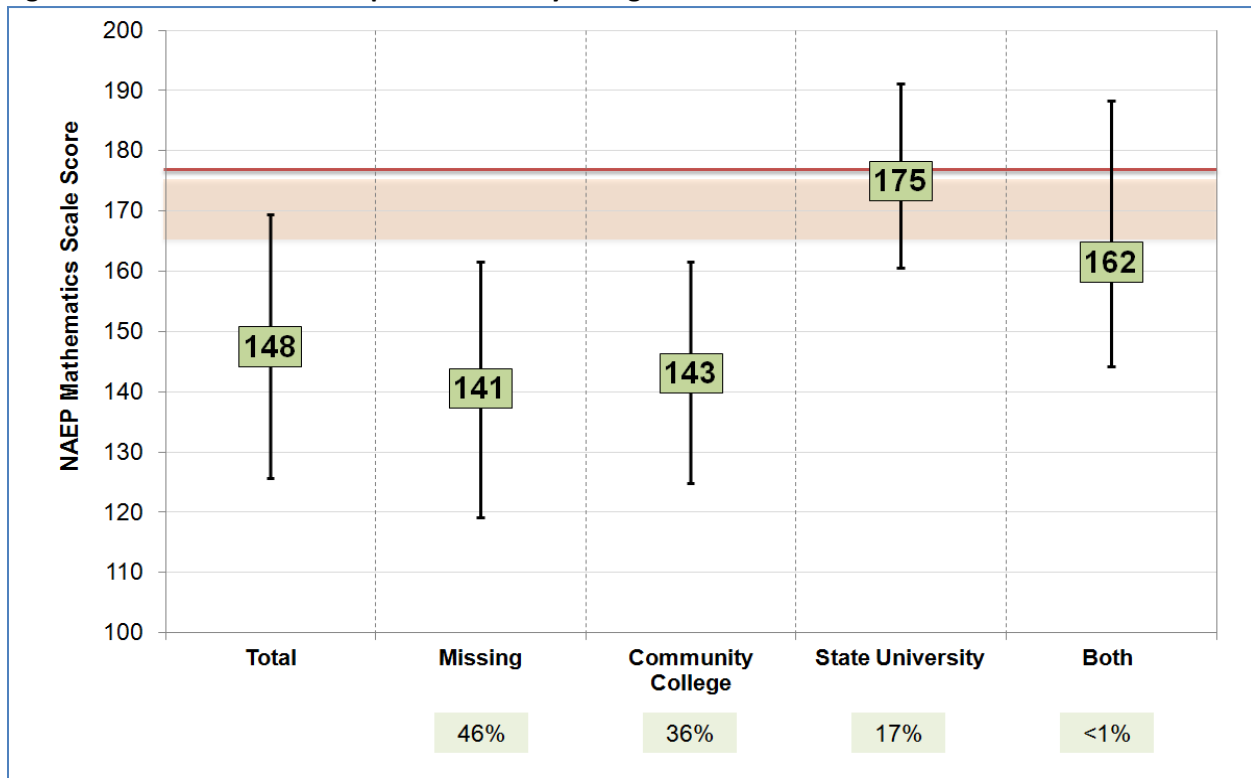


**Figure 5b: NAEP reading performance by self-reported program of high school study**

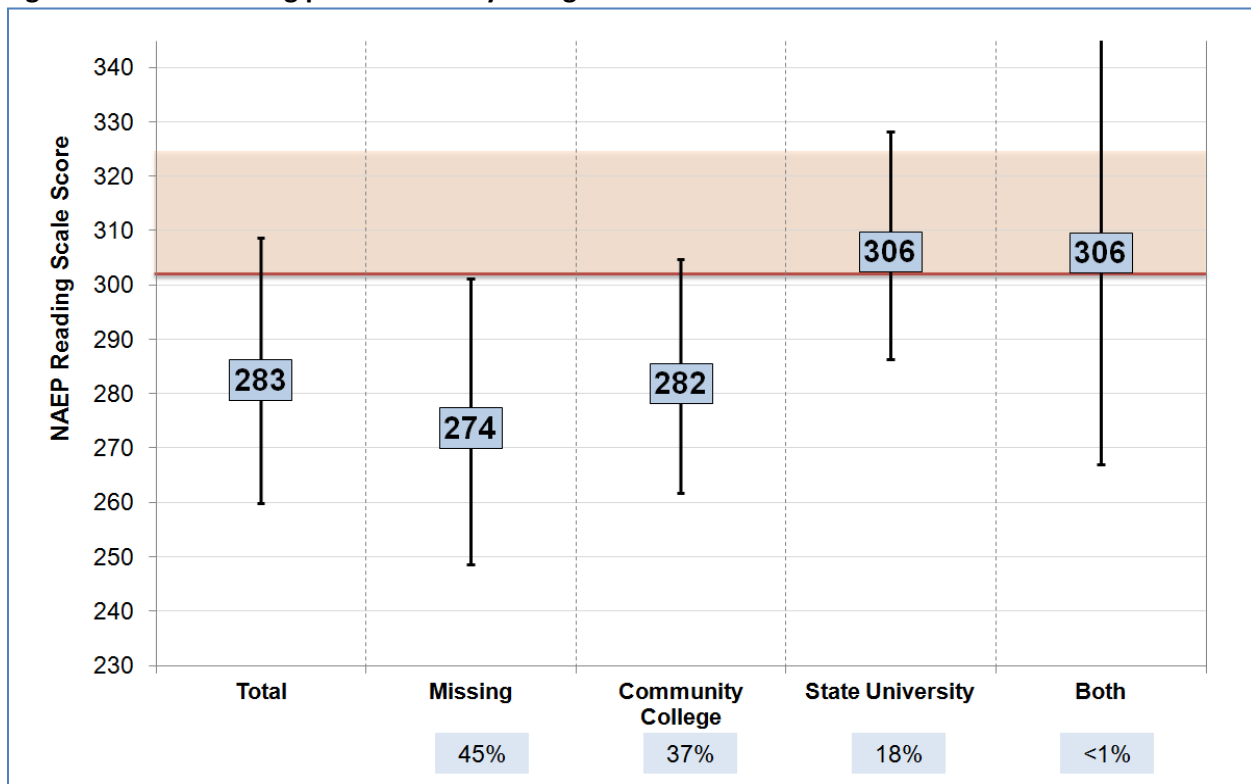




**Figure 6a: NAEP mathematics performance by college enrollment**



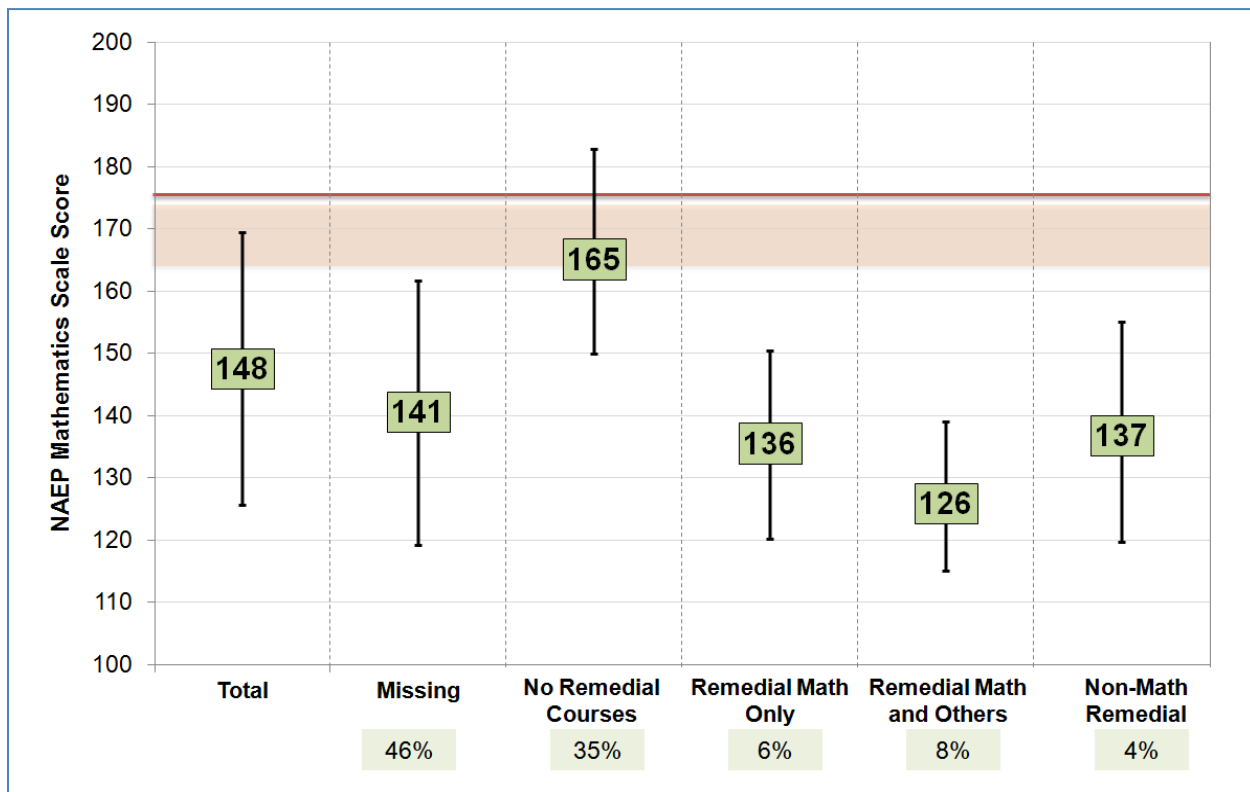
**Figure 6b: NAEP reading performance by college enrollment**



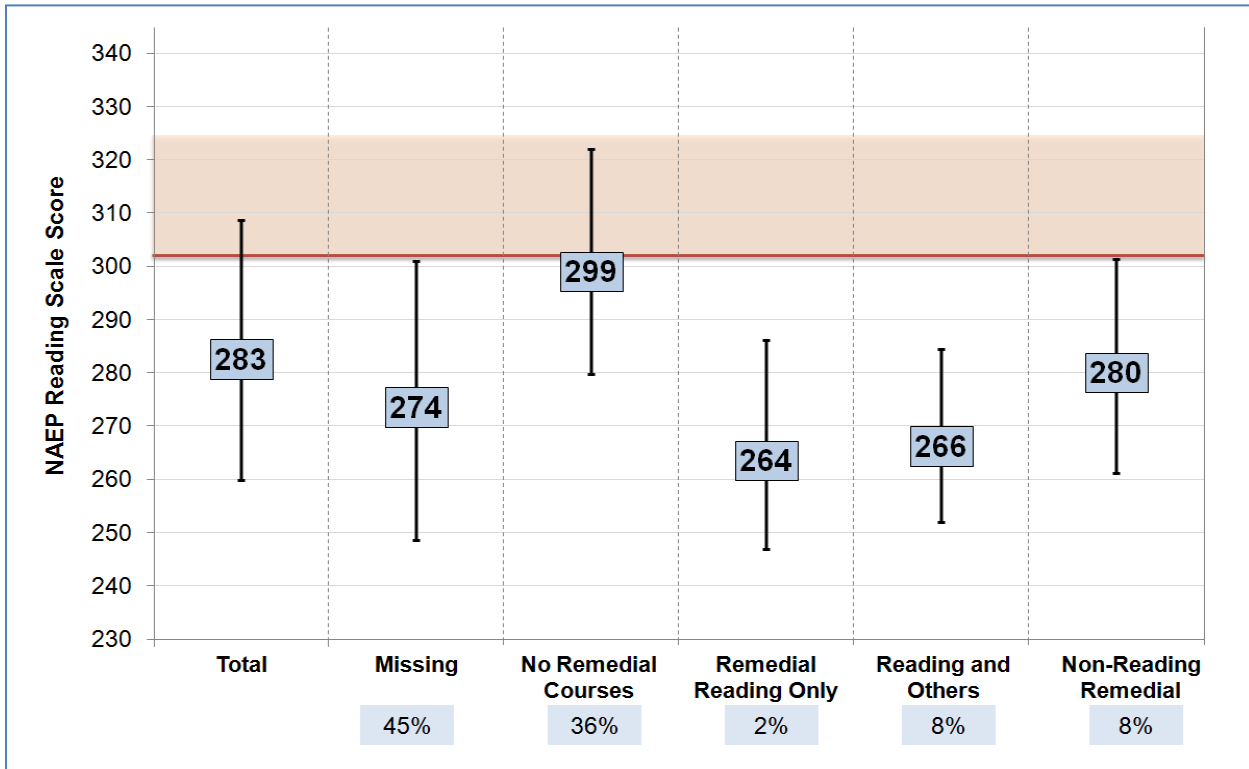
Figures 6a and 6b depict the relationship of NAEP with college enrollment. It is important to note that the missing category contains a diverse group of students, including students who did not attend college, students who attended private schools in Florida, and students who attended colleges out of state. Average NAEP scores for students attending four-year state universities were close to the potential NAEP preparedness reference points, whereas average scores for their peers attending community colleges were below the reference points. Performance on NAEP of students in the missing category appeared relatively similar to those attending community colleges although, as expected, spanning a wider range of performances, particularly towards the lower end. The pattern was similar for both mathematics and reading. The rightmost data (for the category labeled “Both”) represents students taking courses in both community college and a state university. Note however that group is very small with less than 1% of students.

Figures 7a and 7b provide results for first-year college course taking, particularly whether students were enrolled in remedial courses. Similar to figures 6a and 6b, the missing category contains a host of situations ranging from Ivy League attendees to those not enrolled in college at all. The figures show that a substantially greater percentage of students taking no remedial courses during the first year of college scored at or above the NAEP preparedness reference points compared to students who required one or more remedial courses. The pattern was consistent for mathematics and reading and no particular pattern was found regarding the subject matter of the remedial course.

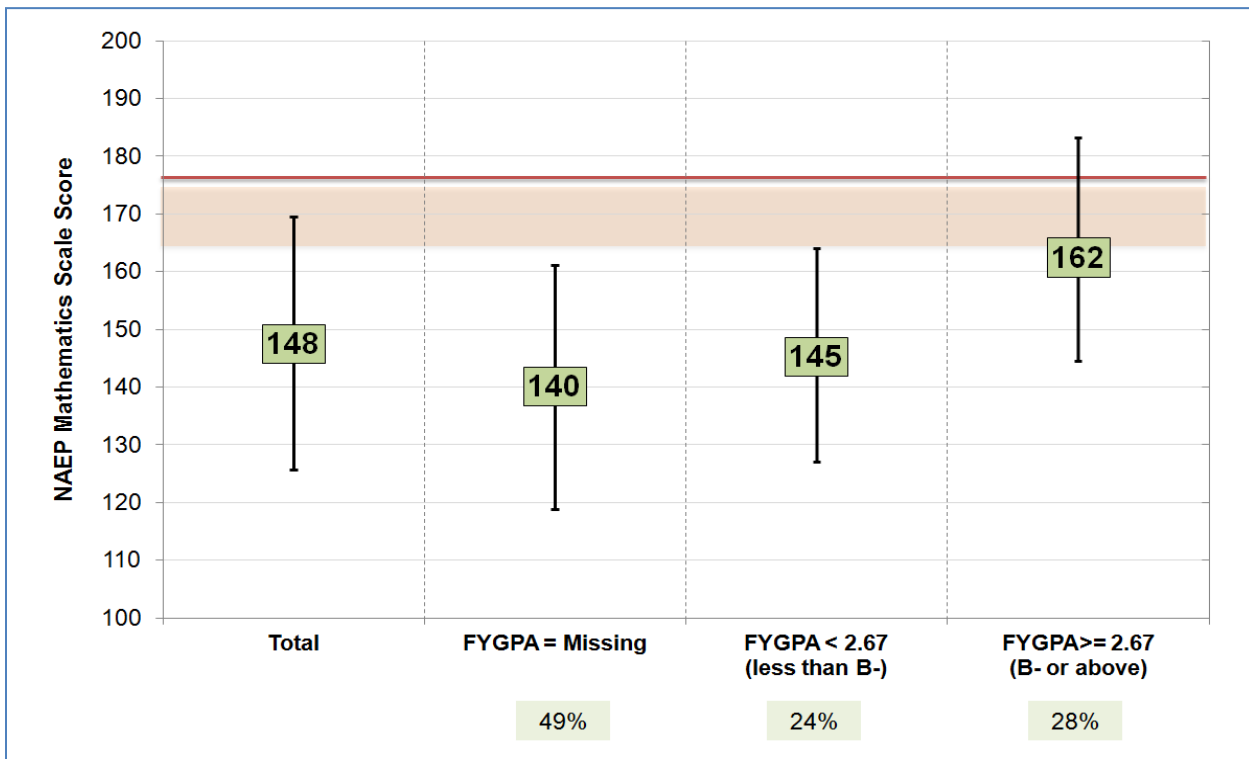
**Figure 7a: NAEP mathematics performance by first-year college course-taking: remedial or credit-bearing**



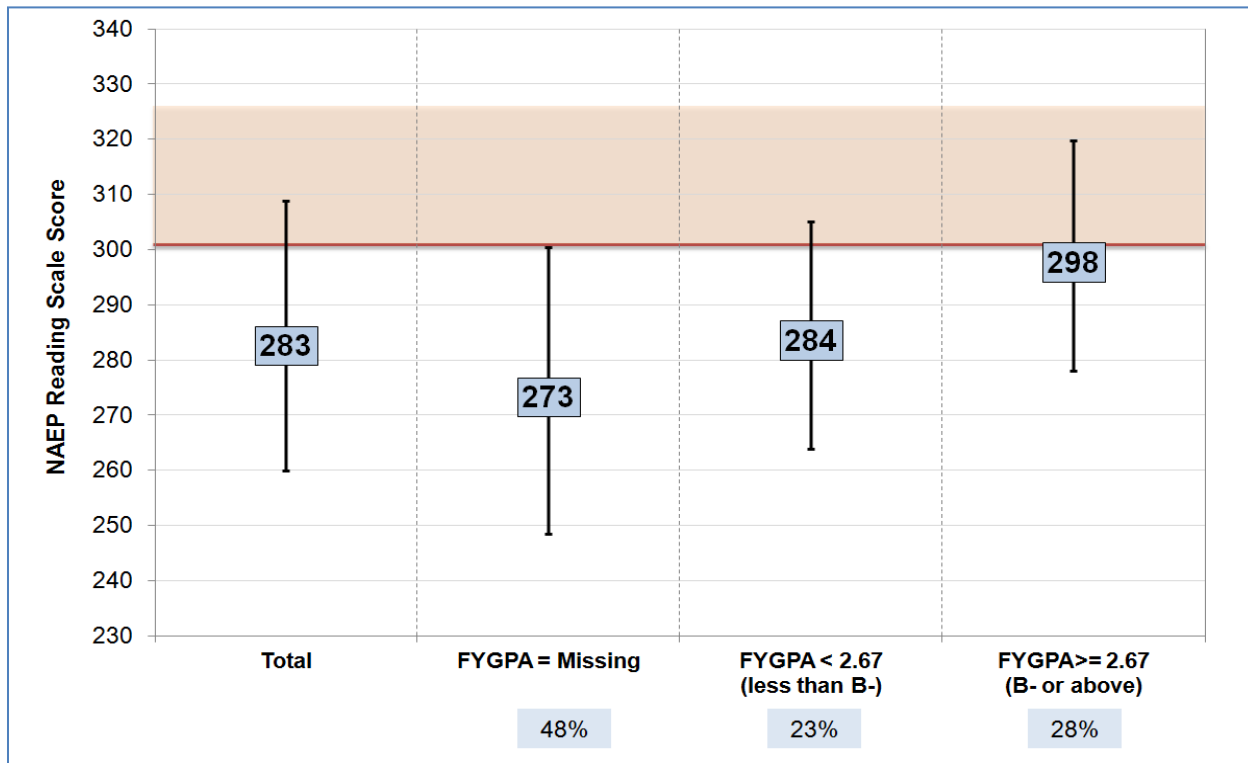
**Figure 7b: NAEP reading performance by first-year college course-taking: remedial or credit-bearing**



**Figure 8a: NAEP mathematics performance by first-year college grade point average: above or below B-**



**Figure 8b: NAEP reading performance by first-year college grade point average: above or below B-**



Finally, NAEP performance was examined in relation to first-year college grade point average (GPA), which plays an important part of various preparedness benchmarks, particularly the GPA of B-. Figures 8a and 8b show that a greater percentage of students achieving GPA of B- or better during their first year of college scored at or above the NAEP preparedness reference points compared to students whose GPA was less than a B- during their first year of college. The pattern was consistent for mathematics and reading.

## Conclusion

A number of indicators of postsecondary preparedness from the Florida Data Warehouse, such as college enrollment status and first-year college grade point averages, were studied in terms of their relationship to NAEP and, in particular, various potential benchmark points that were established based on national NAEP-SAT linking data. The results show relatively weak relationships with NAEP results, which would make these indicators relatively poor predictors with which to determine a preparedness benchmark on the NAEP scale. However, the purpose of this study was not to establish benchmarks, but to provide validity evidence (or disconfirming evidence) to the already-established benchmark region. These results generally indicate that this benchmark region is reasonable and certainly no evidence was found that would indicate that this region is unreasonable.

The limitations of the Florida data, namely the availability of data only for students enrolled in Florida public postsecondary institutions, must be taken into consideration when interpreting these results. Appendix A provides more details about the number and percentages of matched students that were used to support the findings in this memorandum.

## References

ACT. (2010). *What Are ACT's College Readiness Benchmarks?* Iowa City, IA: Author.

Wyatt, J., Kobrin, J., Wiley, A., Camara, W., & Proestler, N. (2011). *SAT Benchmarks: Development of a College Readiness Benchmark and its Relationship to Secondary and Postsecondary School Performance* (Research Report No. 2011-5). New York: College Board.

## Appendix A

Figure A.1 provides sample sizes and percentages for the 2009 NAEP 12<sup>th</sup> grade Florida sample disaggregated by high school program, test-taking, college attendance, and remedial course-taking.

**Figure A.1: Sample sizes and Percentages for 2009 NAEP/Florida Grade 12 Math**

