# NAEP Grade 12 Academic Preparedness Research:
# Analyses Relating Michigan Students' Performance on NAEP to Postsecondary Performance

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# Introduction

Starting in early 2003, the National Assessment Governing Board (Governing Board) embarked on an ambitious mission to redesign grade 12 assessments and reporting as recommended by the National Commission on 12th Grade Assessment and Reporting. The commission recommended that a state program similar to the 4th and 8th grades should be implemented at grade 12 and that NAEP should start reporting on the readiness of 12th graders for college, training for employment, and entrance into the military. As a result of the second recommendation, a number of studies were conducted to assess whether and in what ways NAEP could report on *academic preparedness*.

The Phase I of this research endeavor was concluded with more than 30 studies using the 2009 NAEP grade 12 Reading and Math data. The Phase I research findings supported inferences about NAEP performance and academic preparedness for college (Governing Board preparedness research website[1]) and identified potential benchmarks on the 12th grade NAEP Reading and Math scales to indicate a reasonable probability of being academically prepared (Fields, 2014). According to the Governing Board definition, to be "academically prepared for college," 12th graders should have the knowledge and skills in Reading and Math to qualify for placement into entry-level college credit courses that meet general education requirements, without the need for remedial coursework in either subject.  A scale score of 302 on the NAEP grade 12 Reading assessment (equivalent to the *NAEP Proficient* cut score) and 163 on the NAEP grade 12 Math assessment (between the *NAEP Basic* cut score of 141 and the *NAEP Proficient* cut score of 176) were identified to project a reasonable probability of being academically prepared for college. As a result, the percentage of 12th grade students in the U.S. who were academically prepared for college has been estimated and reported beginning with the 2013 assessments in Reading and Math. Extensive details about the Phase I research work can be found in Fields (2014) and the Governing Board preparedness research website.

As part of the Phase I research efforts, Florida participated in the research by providing longitudinal data that could be linked to the Florida students' performance on the 2009 NAEP grade 12 Reading and Math.  These data were a critical component for the validity evaluation of the benchmarks identified by the statistical linking study conducted in Phase I. The Florida longitudinal study results can be found in Moran, Freund, and Oranje (2012).

In the second phase of the Governing Board's academic preparedness research, additional state partners agreed to provide longitudinal data that can be linked to the 2013 NAEP Reading and Math assessments at grades 8 and 12. Michigan, as one of the state partners, participated in the state-level statistical linking research connecting NAEP and ACT scores and provided data on students who were part of the NAEP grade 12 sample during the 2012-2013 school year. The statistical linking study connecting Michigan students' performance on the NAEP and ACT assessments was completed and documented in a separate report (Xi, Lin, Jerry, Freund, and Oranje, 2016). The current report describes the relationship between the performance on NAEP and postsecondary outcomes observed from the Michigan longitudinal data.

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[1] Governing Board preparedness research website: https://www.nagb.gov/focus-areas/reports/preparedness-research.html

## Data

This study used data from Michigan public school students who participated in the 2013 NAEP grade 12 Reading and Math assessments. Whereas grade 12 NAEP assessments in Reading and Math are in general administered to only nationally representative samples, 13 states (Arkansas, Connecticut, Florida, Idaho, Illinois, Iowa, Massachusetts, Michigan, New Hampshire, New Jersey, South Dakota, Tennessee, and West Virginia) volunteered to participate in a twelfth-grade state pilot program in 2013. From late January to early March 2013, NAEP assessments in Reading and Math were administered nationwide. In Michigan, about 2,900 and 3,100 students at grade 12 were assessed in Reading and Math, respectively. Sample sizes were rounded to the nearest hundred as required by the NCES Statistical Standards.

The process of matching longitudinal data to 2013 NAEP participants in Michigan was carried out through an agreement between the National Assessment Governing Board and the National Center for Education Statistics to have NAEP contractors Westat and ETS conduct the preparedness research work. In addition, data confidentiality agreements were established between all parties involved and the Michigan Department of Education. The Michigan Department of Education provided six years of longitudinal data that cover year 1 through year 6 out of high school for those 12th graders who took grade 12 NAEP assessments in 2013. Information provided by the longitudinal data include college enrollment, remedial course taking, GPA, and degrees obtained. Confidentiality of the students and student data was assured through the assignment of a pseudo ID for students. The pseudo ID was employed as a way to transfer student data to ETS *without* the need to include Personally Identifiable Information (PII) such as names and birthdates. Similarly, the pseudo ID was appended to the NAEP files by Westat who then provided that file to ETS, again *without* any PII. Via the pseudo ID, ETS subsequently matched longitudinal data to NAEP files. The overall matching rate between the NAEP sample and the longitudinal data is 98%.

## Research Questions

The intention of the current study is to examine the relationship between performance on NAEP and postsecondary outcome for the Michigan 12th graders who took NAEP Reading and Math assessments in 2013. The longitudinal information was collected to pursue the following four research questions in accordance with the data sharing agreement:

1. What are the average grade 12 NAEP Reading and Math scores (and the IQR) for students who enroll in remedial and non-remedial courses?
2. What are the average grade 12 NAEP Reading and Math scores (and the IQR) for students with a first-year GPA of B- or above?
3. What are the average grade 12 NAEP Reading and Math scores (and the IQR) for students who remain in college after each year?
4. What are the average grade 12 NAEP Reading and Math scores (and the IQR) for students who graduate from college within 6 years?

The next section will provide details on how the longitudinal data were used to answer each research question, along with plots and summaries that help readers interpret the results.

# Analysis Results

## Interpretation of Figures

The relationships between grade 12 NAEP performance and postsecondary outcomes are displayed in boxplots, which is a standardized way to show distribution of data based on summary statistics such as the average, 5th, 25th, 75th, and 95th percentiles. The current report concerns the four research questions that request information on average and IQR. Therefore, the boxplots showed in this report will be constructed specifically to display the average, 25th, and 75th percentile of considered distributions.

**Figure 1** presents an example of boxplot used in the current report. The NAEP sample matched to the longitudinal data will first be classified into categories of interest based on each research question. The average NAEP scale score, 25th, and 75th percentiles of each category will then be computed and displayed in a boxplot. Taking "Category 1" in Figure 1 as an example. The number in the box represents the average NAEP scale score of this category, while the ends of the whiskers are the 25th and 75th percentiles of the same category. The number above "Category 1" indicates the weighted percentage of this category out of the matched sample. As a reference, the distributional information of the total Michigan NAEP sample before matching (i.e., "Total MI Sample" in Figure 1), is also shown in each figure, but separated from the matched sample by a solid black line. The four horizontal lines indicate the *NAEP Basic*, *NAEP Proficient,* and *NAEP Advanced* cut scores of the corresponding subject, as well as the Preparedness Benchmark identified by the Phase I research studies (Fields, 2014). Notice that for NAEP Reading, the Preparedness Benchmark coincides with the *NAEP Proficient* cut score, and therefore only three red horizontal lines are shown in the Reading plots (Preparedness Benchmark line is shown in blue for Math).

To understand the relationship between the grade 12 NAEP performance and each postsecondary outcome variable, one needs to compare the boxplots between different categories to see whether the average NAEP scale score changes from one category to another and if so whether the difference is in a direction one would expect.

**FIGURE 1: ILLUSTRATION OF BOXPLOT**
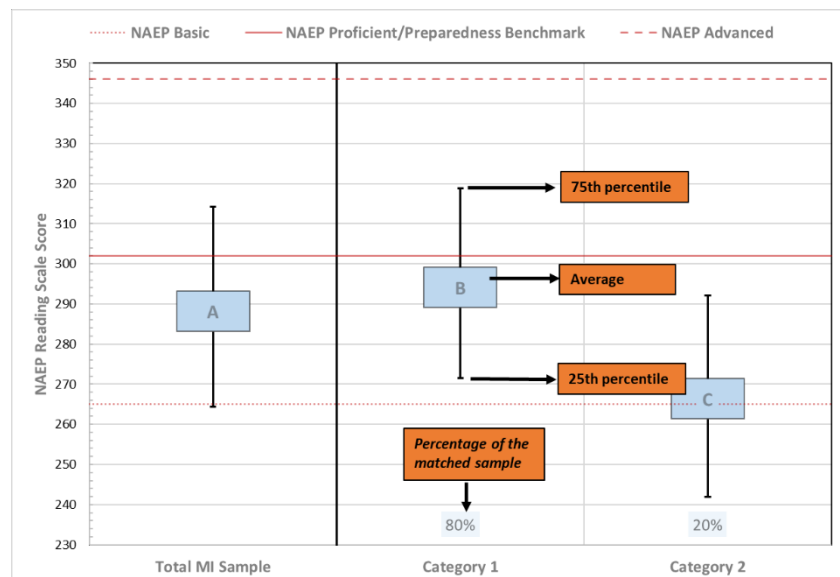
## RQ1: What are the average grade 12 NAEP Reading and Math scores (and the IQR) for students who enroll in remedial and non-remedial courses?

The longitudinal data provided by the Michigan Department of Education include an indicator of college enrollment status for each academic year starting from the 2013-2014 through the 2018-2019 academic year. If this indicator is "No" for a student throughout these six years, he/she will be classified as *never enrolled in college*. Otherwise, he/she will be further categorized as *took at least 1 remedial course* or *never took remedial course* depending on his/her remedial course enrollment indicators.

**Figure 2** and **Figure 3** depict the relationship between remedial course enrollment status and grade 12 NAEP Reading and Math performance, respectively. The NAEP performance of the overall grade 12 Michigan sample (before matching) is shown on the left of these two figures as a reference. These two figures show that between 67% and 68% of the matched Michigan 12th graders have never taken any remedial courses, about 13% have enrolled in at least one remedial course, while the other 20% never enrolled in college. Students who have never taken any remedial courses performed better on the NAEP assessments, with an average score close to (but still lower than) the corresponding *NAEP Proficient* cut score.

The average NAEP Reading scale score of those who have never taken any remedial courses is 298, very close to the *NAEP Proficient* cut score/Preparedness Benchmark identified for Reading (302) and the corresponding 25th and 75th percentiles are 276 and 322 (IQR=46). In comparison, the average NAEP Reading scale score of those who have taken at least one remedial course is 274, and the corresponding 25th and 75th percentiles are 255 and 295 (IQR=40).

The average NAEP Math scale score of those who have never taken any remedial courses is 164, below the *NAEP Proficient* cut score for Math (176) but slightly above the Preparedness Benchmark identified for Math (163). The corresponding 25th and 75th percentiles are 146 and 185 (IQR=39). In comparison, the average NAEP Math scale score of those who have taken at least one remedial course is 136, and the corresponding 25th and 75th percentiles are 122 and 152 (IQR=30).

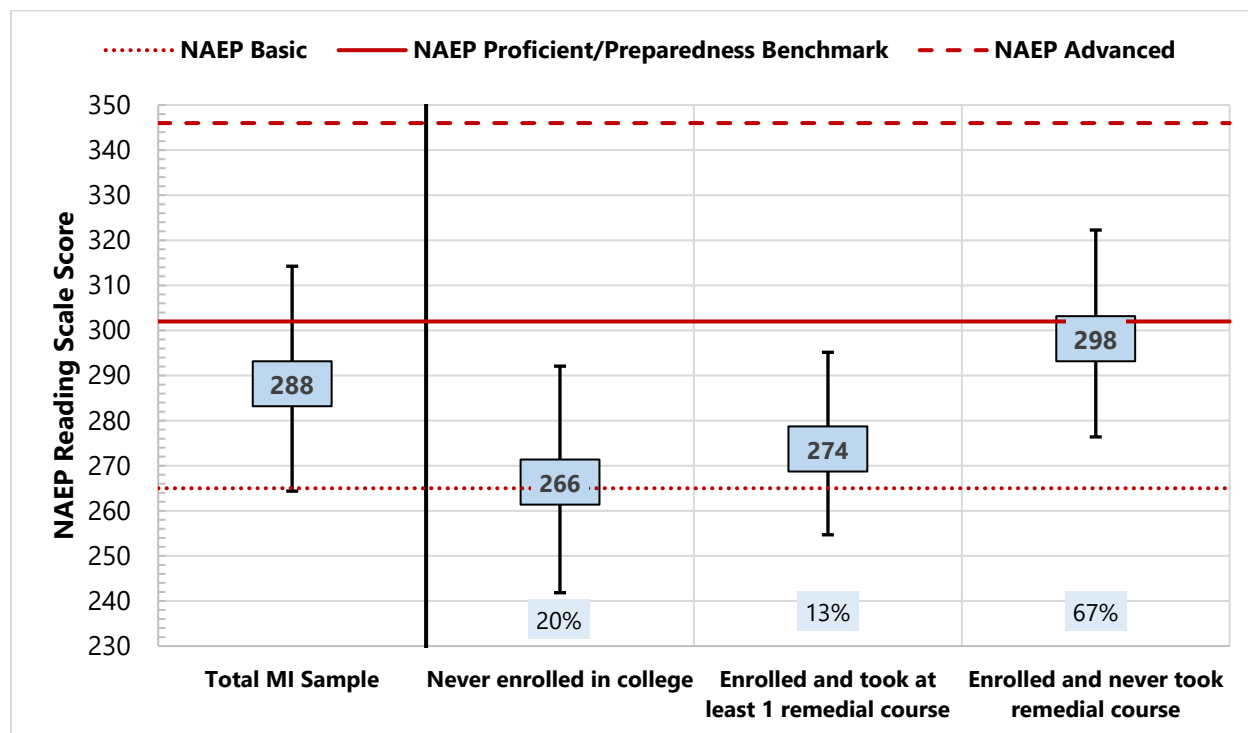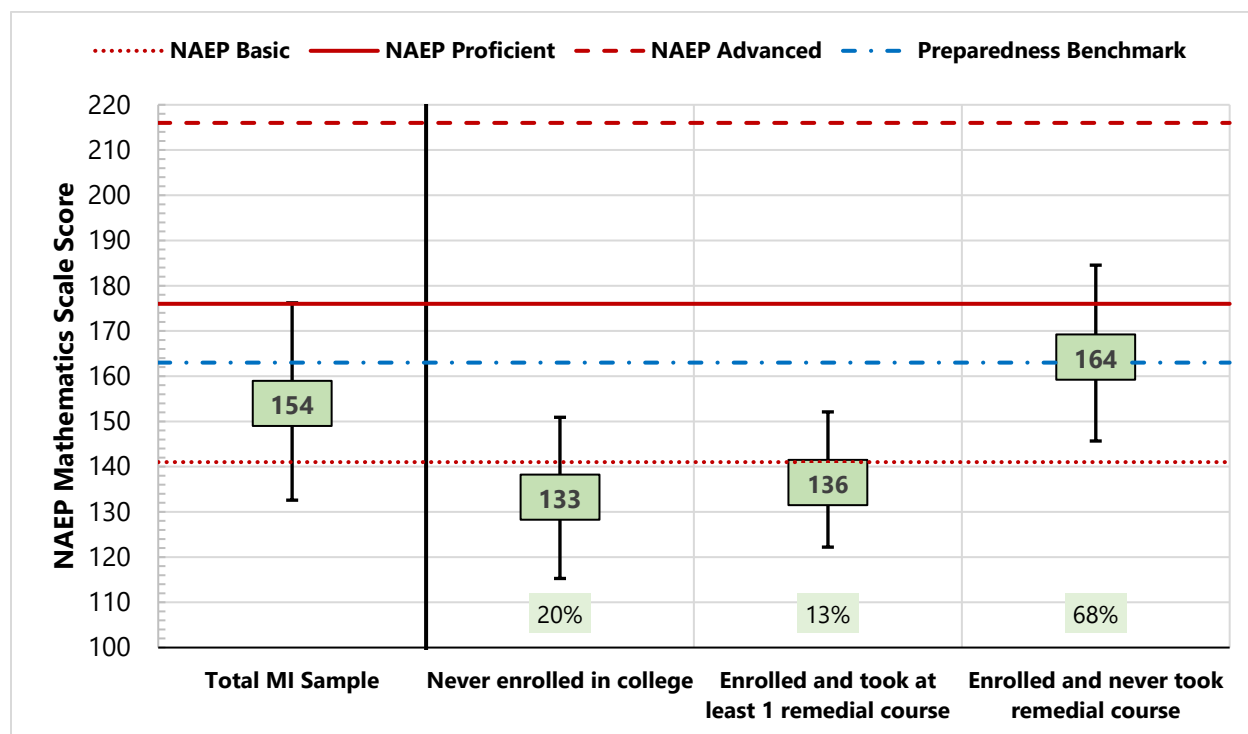**FIGURE 2: NAEP GRADE 12 READING PERFORMANCE BY STUDENT ENROLLED IN REMEDIAL COURSES**



**FIGURE 3: NAEP GRADE 12 MATH PERFORMANCE BY STUDENT ENROLLED IN REMEDIAL COURSES**

## RQ2: What are the average grade 12 NAEP Reading and Math scores (and the IQR) for students with a first-year GPA of B- or above?

Based on the matched sample's enrollment status during the 2013-2014 academic year and their GPA record, students were categorized into the following four categories:

- Not enrolled in college 2013-2014
- Enrolled 2013-2014 but no GPA available
- First-year GPA (2013-2014) < 2.5
- First-year GPA (2013-2014) >= 2.5

**Figure 4** and **Figure 5** provide a graphical summary of the relationship between first-year GPA (FYGPA) and grade 12 NAEP performance. These two figures show that, of the matched grade 12 Michigan sample, between 32% and 33% had a FYGPA at B- or above[2], 15% had a FYGPA below B-, and the rest 53% were either not enrolled in the 2013-2014 academic year or enrolled but with no GPA available. Students who had a FYGPA at B- or above had an average NAEP Reading scale score of 305, above the *NAEP Proficient* cut score (302). The corresponding 25% and 75% percentiles are 285 and 327 (IQR=42). The average NAEP Math scale score for those who had a FYGPA at B- or above was 169, below the *NAEP Proficient* cut score (176) but above the Preparedness Benchmark (163). The corresponding 25% and 75% percentiles are 151 and 189 (IQR=38). Students who enrolled in the 2013-2014 academic year but with no GPA available had the second highest average NAEP scale scores among the four categories, suggesting that this category may also include some of the higher-performing students.

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[2] A 2.5 grade point average (GPA) from a possible 4.0 total GPA is equal to a B- letter grade.

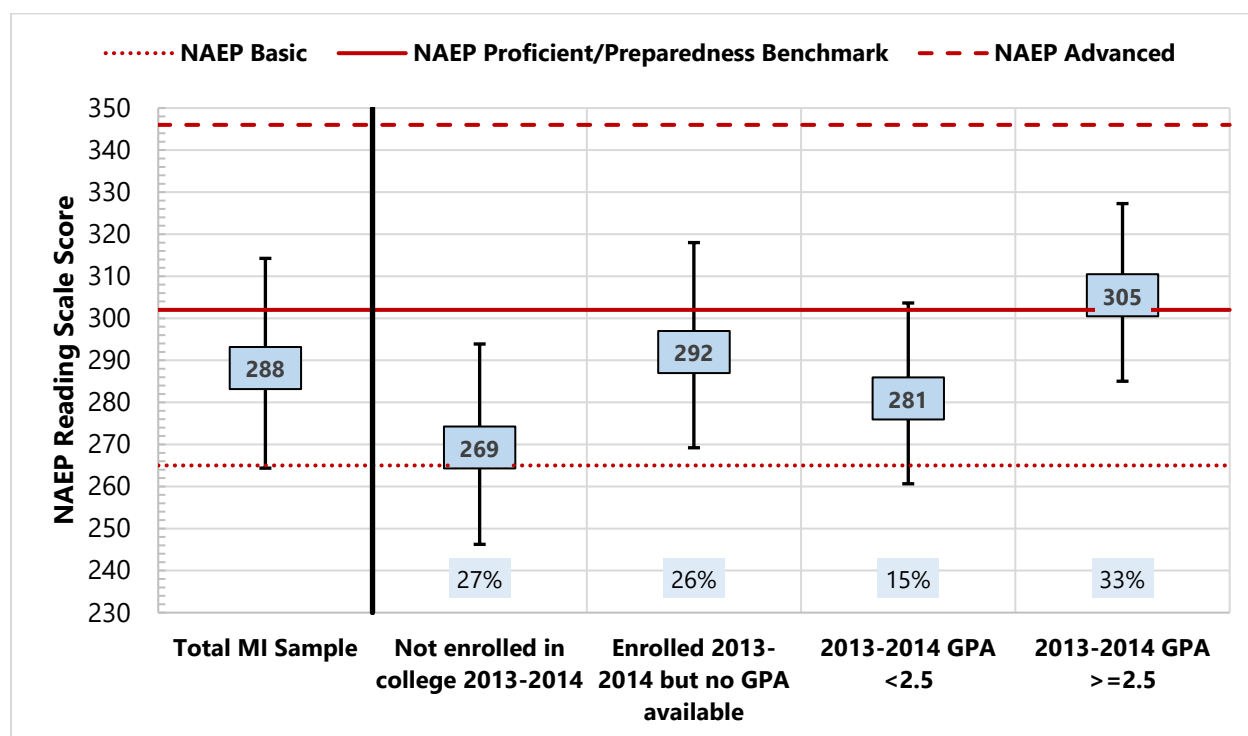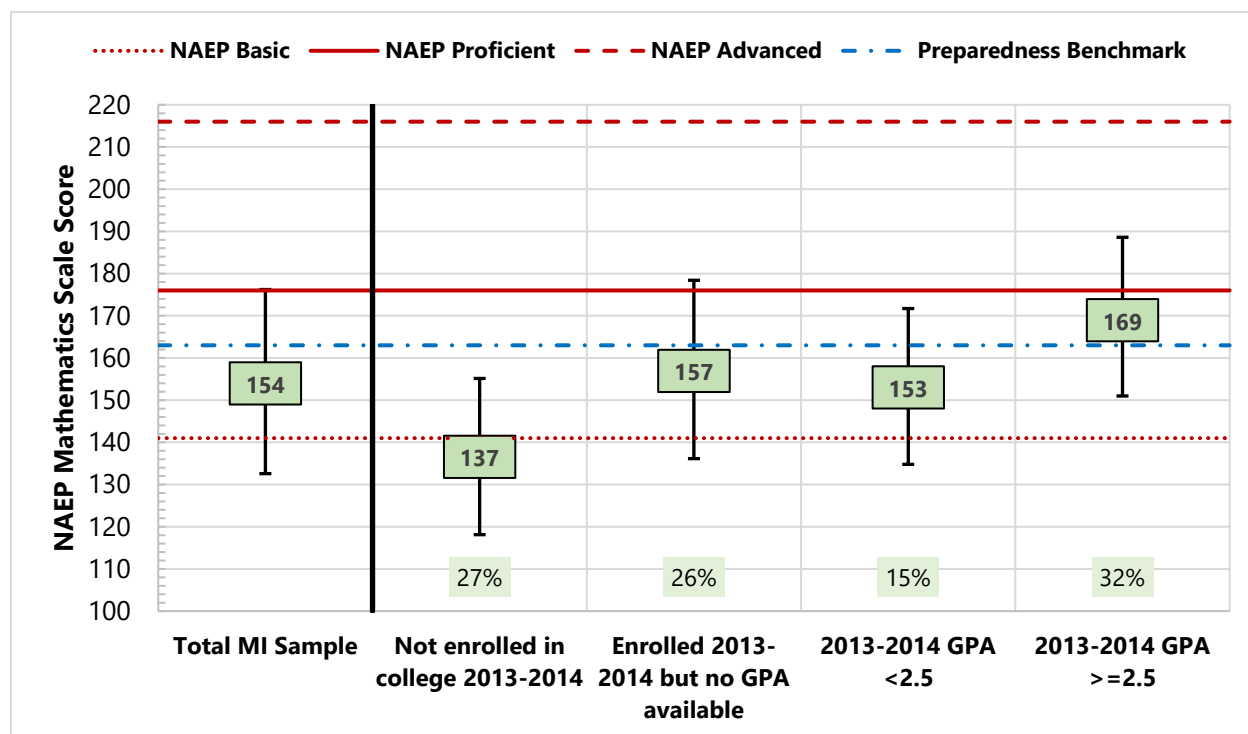**FIGURE 4 NAEP GRADE 12 READING PERFORMANCE BY FIRST-YEAR GPA**



**FIGURE 5 NAEP GRADE 12 MATH PERFORMANCE BY FIRST-YEAR GPA**

## RQ3: What are the average grade 12 NAEP Reading and Math scores (and the IQR) for students who remain in college after each year?

To define "remain in college after each year," students were categorized beginning with the 2013-2014 academic year by consecutive years of enrollment, into the following seven categories:

- Not enrolled 2013-2014 (year 1)
- Enrolled 2013-2014 (year 1) but not 2014-2015 (year 2)
- Enrolled 2013-2015 (year 1 to year 2) but not 2015-2016 (year 3)
- Enrolled 2013-2016 (year 1 to year 3) but not 2016-2017 (year 4)
- Enrolled 2013-2017 (year 1 to year 4) but not 2017-2018 (year 5)
- Enrolled 2013-2018 (year 1 to year 5) but not 2018-2019 (year 6)
- Enrolled 2013-2019 (year 1 to year 6)

If there was a break and then resumption in enrollment, the student is kept in the lower category. For example, a student who enrolled in 2013-2014, took a break in 2014-2015, and then enrolled again in 2015-2016 is kept in the category of "Enrolled 2013-2014, but not 2014-2015". Given that there were students representing nearly every combination of enrollment years, it was determined that looking only at consecutive years of enrollment was the most straightforward and consistent approach.

**Figure 6** and **Figure 7** display the relationship between the grade 12 NAEP performance on Reading and Math and consecutive years of enrollment. In general, these two figures suggest a positive relationship between grade 12 NAEP performance and consecutive years of college enrollment, with the fifth category (i.e., "Enrolled 2013-2017 but not 2017-2018") having the highest average NAEP scale score for both Reading and Math. Students who enrolled in 2013-2017 but not 2017-2018 had an average NAEP Reading scale score of 311, above the corresponding *NAEP Proficient* cut score (302). Students who enrolled in 2013-2017 but not 2017-2018 had an average NAEP Math scale score of 172, only 4 points below the corresponding *NAEP Proficient* cut score (176) and above the Preparedness Benchmark identified for NAEP Math (163). Students in the last two categories, i.e., "Enrolled 2013-2018 but not 2018-2019" and "Enrolled 2013-2019", also had average NAEP scale scores close to or above the corresponding *NAEP Proficient* cut scores, suggesting a positive relationship between grade 12 NAEP performance and perseverance.

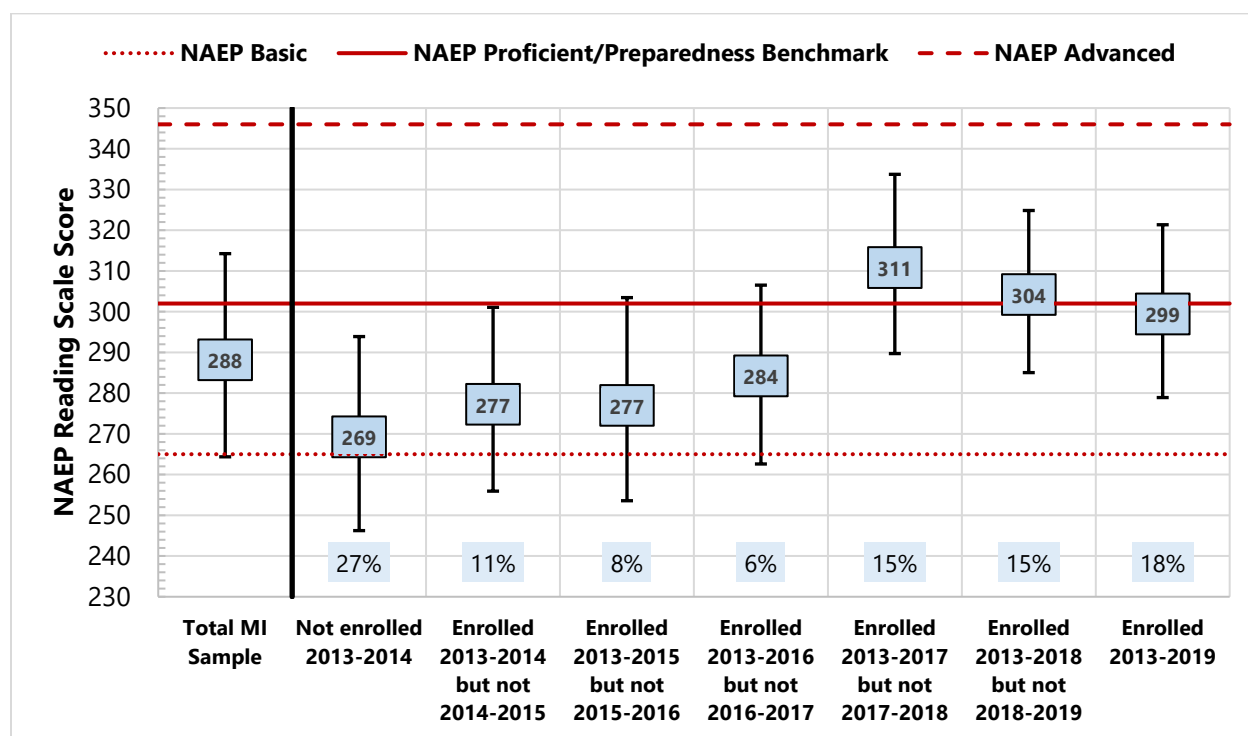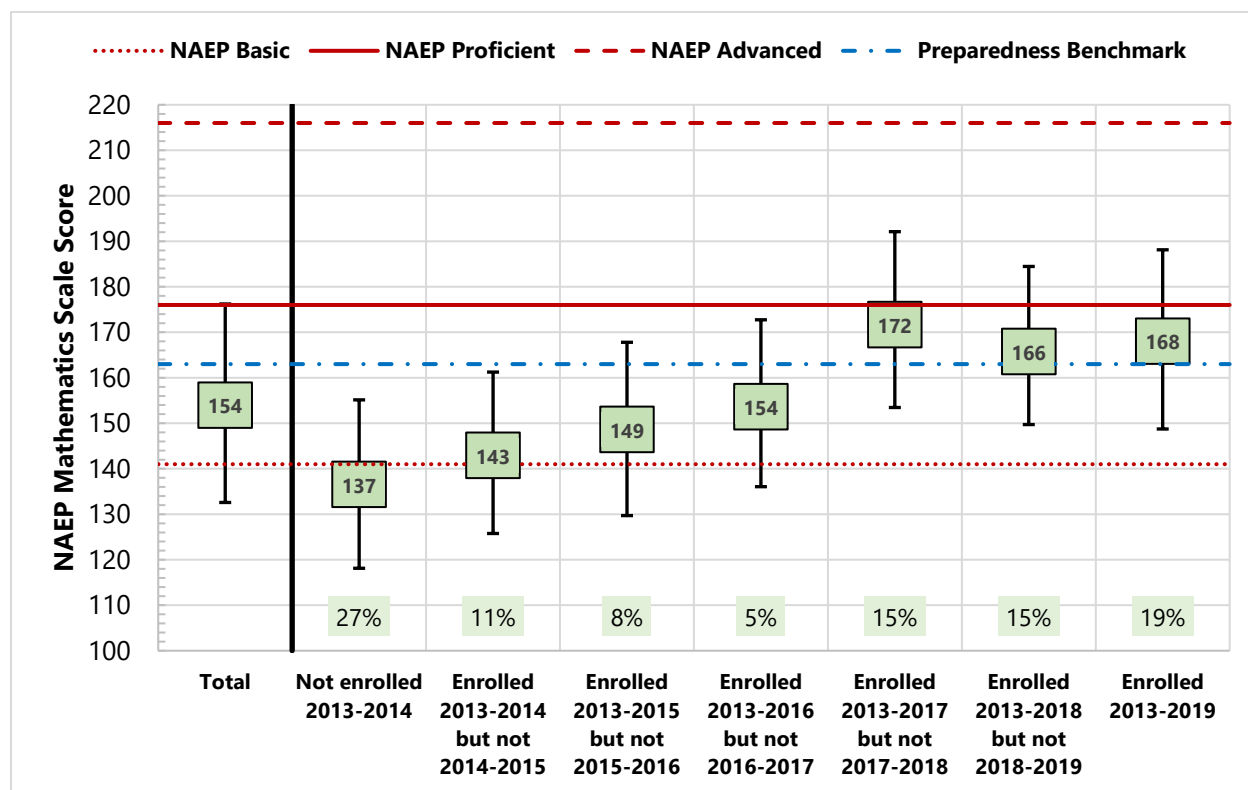**FIGURE 6: NAEP GRADE 12 READING PERFORMANCE BY YEARS OF ENROLLMENT**



**FIGURE 7: NAEP GRADE 12 MATH PERFORMANCE BY YEARS OF ENROLLMENT**

## RQ4: What are the average grade 12 NAEP Reading and Math scores (and the IQR) for students who graduate from college within 6 years?

By combining the college enrollment status and the information on degrees received, students are categorized into the following four categories:

- Never enrolled in college
- Enrolled but did not receive any degree/certificate
- Enrolled and achieved degree/certificate less than Bachelor's
- Received Bachelor's, Baccalaureate, or Master's degree

Students who received various certificates or Associate's degrees were put into the third category, i.e., "Enrolled and achieved degree/certificate less than Bachelor's", and students who received a Bachelor's, Baccalaureate, or Master's degree were put into the fourth category. The last two categories are of particular interest to the current research question, as the students classified in these two categories can be considered "graduate from college within 6 years".

**Figure 8** and **Figure 9** provide information on the relationship between grade 12 NAEP performance and college graduation status with award level. Of the matched grade 12 Michigan sample, about 42% completed college within 6 years (depending on the matched NAEP subject), and the rest 58% of the matched sample either never enrolled in college or enrolled but did not achieve any degrees. For those who completed college with a degree/certificate less than Bachelor's, their average grade 12 NAEP Reading scale score is 290, and their average grade 12 NAEP Math scale score is 156, both are lower than the corresponding *NAEP Proficient* cut score. For those who achieved a Bachelor's, Baccalaureate, or Master's degree within 6 years, their average grade 12 NAEP Reading scale score is 311, and their average grade 12 NAEP Math scale score is 176, higher than or equal to the corresponding *NAEP Proficient* cut score. Students who never enrolled in college have the lowest average grade 12 NAEP performance, while students who enrolled but did not achieve any degree have the second lowest grade 12 NAEP performance among the four considered categories.

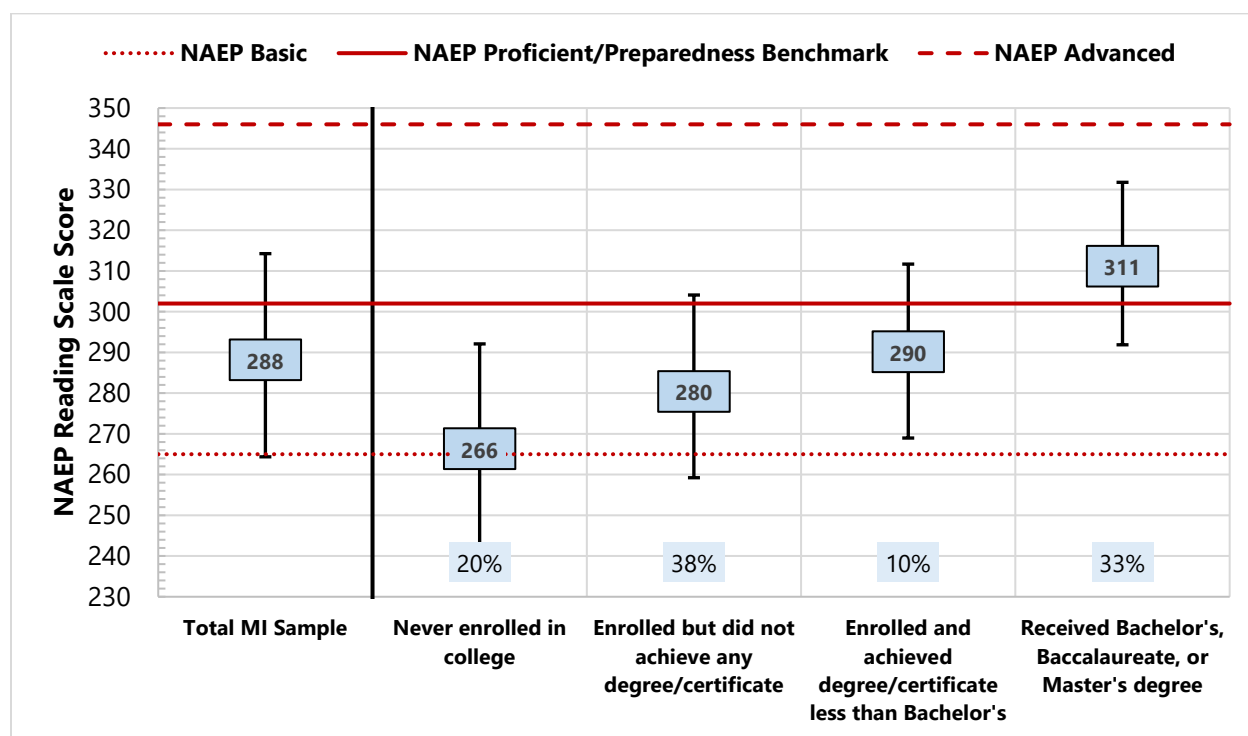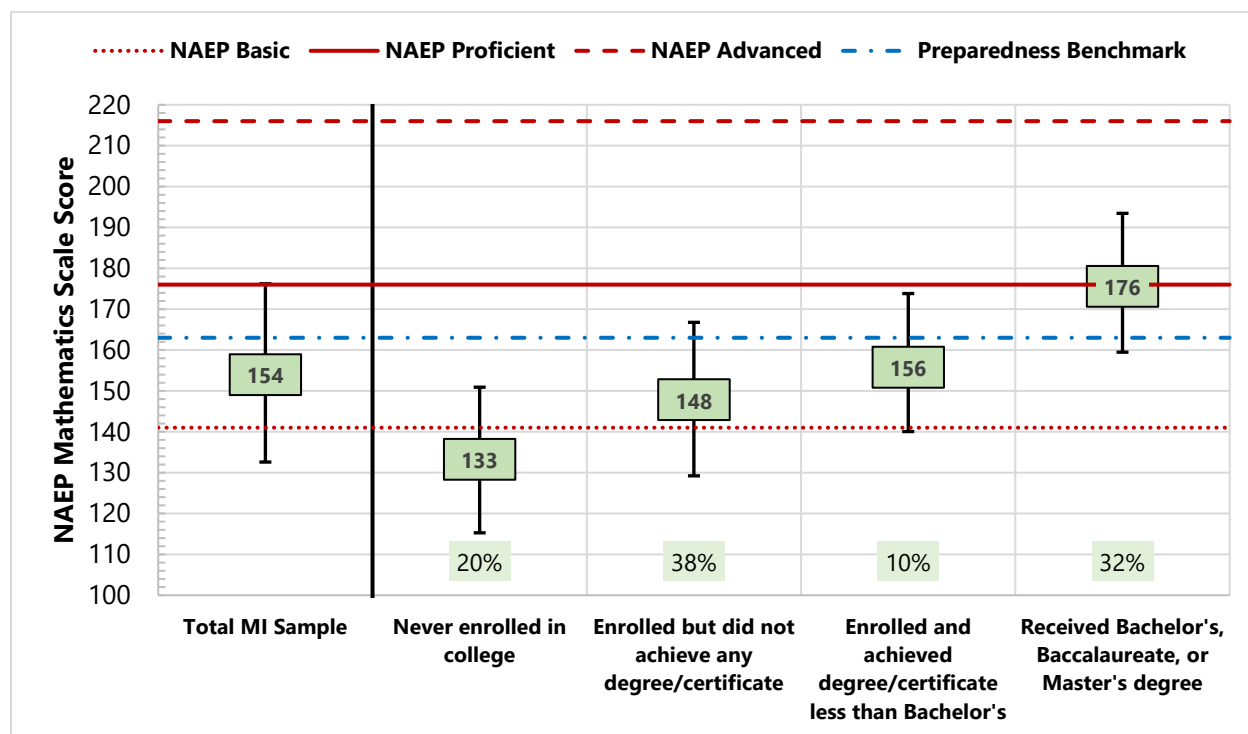**FIGURE 8: NAEP GRADE 12 READING PERFORMANCE BY GRADUATE WITHIN 6 YEARS**



**FIGURE 9: NAEP GRADE 12 MATH PERFORMANCE BY GRADUATE WITHIN 6 YEARS**

# Summary

The current study examines the relationship between the grade 12 NAEP Reading and Math performance and postsecondary academic outcomes for the 2013 Michigan NAEP sample. The NAEP data are matched to the longitudinal data provided by the Michigan State Department of Education through the usage of Pseudo ID, which ensures the confidentiality of student data. The overall matching rate is at 98%.

Four research questions are examined (see **Research Questions**). Analysis results along with plots and summaries are provided for each research question in the **Analysis Results** section. In general, the results suggest that for the matched Michigan 12th graders who took NAEP in 2013, their grade 12 NAEP performance is positively related to their postsecondary outcomes evaluated in this report. For instance, students who enrolled in college and never took remedial courses are associated with better performance on the grade 12 NAEP Reading and Math assessments compared to those who had taken at least one remedial course in college. In fact, the average grade 12 NAEP Reading and Math scale scores of those who never took remedial courses are very close to the Preparedness Benchmark identified for each subject. Recall that the Preparedness Benchmark was set at NAEP scale score that indicates students have required knowledge and skills to be placed into entry-level college credit courses without the need for remedial courses, using the 2009 NAEP national data. Therefore, the closeness between the identified Preparedness Benchmarks and the observed 2013 NAEP performance of the Michigan 12th graders who never took remedial courses could be seen as confirmative and validity evidence for using the Preparedness Benchmarks to indicate 12th graders' academic preparedness for college.

It should be emphasized that the longitudinal data were matched to the Michigan sample who took the 2013 NAEP grade 12 Reading and Math assessments. As the grade 12 NAEP Reading and Math assessments were administered to public school students only, interpretation of the results presented in the current report should be limited to this population (i.e., public school students).

# References

Fields, R. (2014). *Towards the National Assessment of Education Progress (NAEP) as an Indicator of Academic Preparedness for College and Job Training*. Washington, DC: National Assessment Governing Board.

Moran, R., Freund, D., and Oranje, A. (2012). *NAEP 12th Grade Preparedness Research: Analyses Relating Florida Students' Performance on NAEP to Preparedness Indicators and Postsecondary Performance*. Research report prepared for National Assessment Governing Board.

Xi, N., Lin, M., Jerry, L., Freund, D., & Oranje, A. (2016). *NAEP Grade 12 Academic Preparedness Research: Establishing a Statistical Relationship between NAEP and ACT Assessments in Reading and Mathematics for Grade 12 Michigan Students*. Research report prepared for National Assessment Governing Board.