

Final Report

*Study and analyses requested by the
National Board for Professional Teaching Standards*

Comparison of the Effects of NBPTS Certified Teachers with Other Teachers on the Rate Of Student Academic Progress

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March 7, 2005

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This project is funded in part with grants from the U.S. Department of Education and the National Science Foundation. Through September 2005, NBPTS has been appropriated federal funds of \$149.1 million, of which \$136.7 million was expended. Such amount represents approximately 34 percent of the National Board Certification project. Approximately \$261 million (66 percent) of the project's cost was financed by non-federal sources.

The contents of this publication were developed under a grant from the U.S. Department of Education. However, those contents do not necessarily represent the policy of the Department of Education, and you should not assume endorsement by the Federal government.

Executive Summary

National Board Certification is a voluntary process established by the National Board for Professional Teaching Standards (NBPTS) to measure what accomplished teachers should know and be able to do. Certification is achieved through a rigorous performance-based assessment that takes between one and three years to complete. As of November 2004, approximately 40,200 teachers had earned National Board Certification.

This study was undertaken as part of the National Board's continuing effort to measure the impact of National Board Certification and the effects of National Board Certified Teachers (NBCTs) on the quality of teaching and student achievement in America's schools. End-of-grade mathematics and reading test scores from two large North Carolina school districts (Charlotte-Mecklenberg and Wake County) from the 1999-2000 through 2002-2003 school years, grades 4 through 8 were analyzed to compare NBCTs with other teachers. Over 260,000 student records (about half in mathematics and half in reading), representing over 4600 teacher-subject-grade-year combinations, were included in the analyses. Of that 4600+, 281 represented National Board Certified mathematics teacher-years, 306 represented National Board Certified reading teacher-years.

Models were fitted to each of the ten subject-grade combinations (1) using end-of-grade scores as the response variable with end-of-grade scores from the previous year as covariates, and (2) using gain scores (end-of-grade score minus previous year end-of-grade score) as the response variable. Additional explanatory variables included: teacher certification status (the factor of interest), teacher years-of-experience, and the gender and race of the student. A hierarchical model was used to account for the fact that students were nested within teachers. For comparison with other recent studies, non-hierarchical models were fitted as well. Three planned comparisons assessed the differences between NBCTs and other teachers: (1) NBCTs versus teachers who have never been involved in the certification process, (2) NBCTs versus teachers who planned to attain certification in the future, (3) NBCTs versus teachers who failed in their attempt at certification.

Findings. Overall, based on the hierarchical models, students of NBCTs did not have significantly better rates of academic progress than students of other teachers and estimated effect sizes were relatively small. The more relevant and important finding was that the variation among teachers within the same certification status was sufficiently large that

whatever small average differences there were between teachers in different certification status categories were rather meaningless in comparison. As a result, a student randomly assigned to a NBCT is no more likely to get an “effective” (or an “ineffective”) teacher than a student assigned to a non-NBCT.

Implications. The findings of this study do not support the conclusion that, in general, students of NBCTs receive better quality teaching than students of other teachers. This is in contrast to the findings of several other recent studies, none of which used hierarchical models to properly account for the nested structure of the data. Since failure to properly model hierarchically structured data is well-known to produce overly optimistic results, the conclusions from those earlier studies need to be reassessed. If the findings of this North Carolina study are representative of other states, the NBPTS may wish to consider what steps should be taken to strengthen the certification process to better assess teacher quality.

1. Background

National Board Certification is a voluntary process established by the National Board for Professional Teaching Standards (NBPTS), an independent, nonprofit, nonpartisan and nongovernmental organization governed by a board of directors, the majority of whom are classroom teachers. Its mission is to establish high and rigorous standards for what accomplished teachers should know and be able to do. Certification is achieved through a rigorous performance-based assessment that takes between one and three years to complete. As of November 2004, approximately 40,200 teachers had earned National Board Certification.

In its continuing effort to measure the impact of National Board Certification and the effects of National Board Certified Teachers (NBCTs) on the quality of teaching and student achievement in America’s schools, NBPTS has engaged in an extensive, independent, and rigorous research agenda. As part of these continuing research efforts, NBPTS contracted the EVAAS® group at the SAS Institute Inc. to study the impact of NBCTs on the rate of academic progress relative to other teachers who were not certified by the National Board.

2. Data and Models

This study addressed three primary research questions:

1. *Do students of NBCTs make greater academic progress than students of teachers who have never attempted to attain National Board Certification?*
2. *Do students of NBCTs make greater academic progress than students of non-NBCTs who plan to attempt to attain National Board Certification at some point in the future?*
3. *Do students of NBCTs make greater academic progress than teachers who attempted to attain National Board Certification, but who failed in their first attempt?*

Data

To test the three major research questions, end-of-grade test data from two large North Carolina school districts – Charlotte-Mecklenberg and Wake County – from school years 1999-2000 to 2002-2003 were analyzed. North Carolina has consistently ranked first nationwide in terms of numbers of NBCTs, and both districts have substantial numbers of such teachers.

Multiple years of data for students in grades four through eight in reading and mathematics were analyzed.² Multiple cohorts of data for each grade and subject were used in the analyses. Sample sizes of teachers and students varied by grade and by subject, with the numbers of certified teacher-years ranging from 13 to 122, and the number of students ranging from about 16,000 to 37,000, across grades and subjects (see Table 1). A student's record was excluded from the study when one or more of the following conditions were present:

- A linkage could not be established from a teacher and a student record;
- the student record lacked two prior year scores;
- the student was taught in a classroom having 10 or fewer students;
- the race and gender of the student were not known;
- the teacher's experience could not be established;
- and the teacher withdrew from the NBPTS program.

² In 2003 the North Carolina Department of Public Instruction changed its scaling procedures for the state's end-of-grade tests. For the purposes of these analyses, all pre-2003 test data were mapped using translation tables supplied by the Department of Public Instruction.

More than 200,000 student records were examined in reading and mathematics across the five grade levels. Following exclusions for reasons cited above, more than 130,000 records in each subject were used in this study.

Models

The study addressed each of the three primary research questions through four different models. These models form a two-by-two array based on (a) which response variable was used and (b) whether or not a random effect for teacher-within-certification-status was included.

| Model | ResponseVariable | Fixed Effects | Random Effects |
|--------------|----------------------------|--|-------------------------------------|
| 1 | Current Student Test Score | Year, Prev_scores(year), Race, Sex, Teacher Years Experience, NBPTS Certification Status | |
| 2 | Current Student Test Score | Year, Prev_scores(year), Race, Sex, Teacher Years Experience, NBPTS Certification Status | Teacher(NBPTS Certification Status) |
| 3 | Simple Gain | Year, , Race, Sex, Teacher Years Experience, NBPTS Certification Status | |
| 4 | Simple Gain | Year, , Race, Sex, Teacher Years Experience, NBPTS Certification Status | Teacher(NBPTS Certification Status) |

Models 1 and 2 used the current student test score as the response variable with previous year math and reading scores included as fixed effect covariates. Models 3 and 4 used simple gain as the response variable and did not include any previous test scores as covariates. Models 1 and 3 did not include a teacher random effect while models 2 and 4 did include this effect. Additional fixed effects were included in all models as shown in the table above.

In all four models, the effect of interest was the teacher’s NBPTS Certification Status, with four categories: (1) teachers who had already earned National Board Certification, (2)

those who would attempt to obtain National Board Certification in the future, (3) those who attempted and failed to obtain National Board Certification, and (4) those who had never participated in the National Board Certification process.

Models 1 and 3 were included primarily for comparison to earlier studies. Model 1 is similar to that of Cavalluzzo (2004) in the use of the current test score as the response with a previous test score as a covariate. Model 3 is similar to the model used by Goldhaber and Anthony (2004). See Section 4 for more about the findings in these studies.

Models 2 and 4 are analogous to Models 1 and 3, respectively, but also include a random teacher effect with a separate variance component for each certification status. These random effects are used recognizing the hierarchical structure of the data, capturing any systematic difference in performance which is shared by students linked to a particular teacher, but which is unrelated to any measured teacher or student characteristics already in the models. Failure to properly account for the hierarchical structure of the data typically produces inferences that are overly optimistic, and it will be seen below that inclusion/exclusion of the teacher random effect has a dramatic impact on the inferential conclusions that can be drawn from this study. These differences will be explored in some detail in the Discussion section after the Findings are presented. Note that neither the Cavalluzzo (2004) study nor the Goldhaber and Anthony (2004) study included a random effect for teacher.

Each of the four models was run separately for each subject (Math and Reading) and for each grade (4, 5, 6, 7, 8) for a total of ten runs of each model. In each model three planned comparisons were made, comparing Certified teachers to each of the other three categories. Thus, in each model a total of 30 comparisons was made (3 comparisons in each of the 10 subject-grade combinations).

3. Findings

The primary research questions in this study involved comparison of NBPTS certified teachers versus other teachers (see Section 2). These questions are addressed in the following paragraphs with further discussion in Section 4. Results are summarized in Table 2

In Models 1 and 3 students of NBCTs tended to have better average performance, either in terms of larger end-of-grade test scores conditional on prior scores (Model 1) or in terms of larger gain scores (Model 3), than students from other teacher categories (see Table 2 and Tables 3A and 3C). There were more statistically significant effects in mathematics than reading with these models (Math: 9 of 15 with Model 1, 8 of 15 with Model 3; Reading: 4 of 15 with Model 1 one of which was negative!, 2 of 15 with Model 3 one of which was negative). The sizes of the effects were generally less than one-half of a scale score unit and translated to standardized effect sizes that averaged 0.09 and 0.04 for math and reading, respectively, in Model 1, and 0.06 and 0.02 in Model 3. These effect sizes are roughly consistent with those reported by Cavalluzzo (2004) and by Goldhaber and Anthony (2004).

On the other hand, Models 2 and 4, which included teacher random effects, found substantially fewer statistically significant effects (see Tables 2, 3B, 3D), particularly in mathematics (Math: 1 of 15 with Model 2, 1 of 15 with Model 4; Reading: 3 of 15 with Model 2, 1 of 15 with Model 4 and it was negative). Standardized effect sizes average 0.07 and 0.04 for math and reading, respectively, in Model 2, and 0.05 and 0.01 in Model 4.

The dramatic difference in results between Model 1 and Model 2 (or between Model 3 and Model 4) is discussed further in the following section. It is important, however, not to let that discussion distract from what is arguably the most important finding of this study: **the amount of variability among teachers with the same NBPTS Certification Status is considerably larger than the differences between teachers of different Status.** Consequently, a student who is randomly assigned to a National Board Certified teacher is not much more likely to get an “effective” teacher (or an “ineffective” teacher) than a student assigned to a teacher who has never been in the NBPTS process (or one who failed certification, or one who may in the future become certified).

Figures 1 through 10 show the estimated teacher effects obtained using a model similar to Model 2 but with the fixed effect for NBPTS Certification Status omitted from the model. Teachers planning to be certified in the future were omitted from the plots to avoid clutter. As an example, consider Figure 2 (5th grade math). In Model 1 for 5th grade math (which excluded teacher effects), NBCTs were found to be significantly better than other teachers while in Model 2 (with teacher effects) the comparisons were mostly not significant (see Table 2). What Figure 2 shows is the tremendous amount of overlap among teachers of

different certification status. Several of the best teachers (largest positive teacher effects) were NBCTs, but so were some of the least effective teachers. Likewise, among teachers who tried and failed to achieve certification, and among teachers never involved in the certification process, were some of the most and least effective teachers. The ability of the certification process to distinguish effective from ineffective teachers is weak at best, with a high probability of misclassification.

4. Discussion

Although the findings of Models 1 and 3 versus 2 and 4 might appear contradictory, there is a simple but very important explanation for the differences. We focus on Models 1 and 2 in the discussion for clarity. By including teacher random effects, Model 2 accounts for the hierarchical structure of the data (students nested within teachers), which is ignored in Model 1. A wealth of literature exists attesting to the danger of ignoring the nested (or clustered or hierarchical) structure of data sets such as the one analyzed in this study. One useful resource is The Centre for Multilevel Modelling (www.mlwin.com) directed by professor Harvey Goldstein. Because of the importance of this issue in the present study, it seems appropriate to quote at length from this website's Introduction to Multilevel Modelling.

Many kinds of data, including observational data collected in the human and biological sciences, have a hierarchical or clustered structure. ...

To ignore this [hierarchical structure] risks overlooking the importance of group effects, and may also render invalid many of the traditional statistical analysis techniques used for studying data relationships.

A simple example will show its importance. A well known and influential study of primary (elementary) school children carried out in the 1970's (Bennett, 1976) claimed that children exposed to so called 'formal' styles of teaching reading exhibited more progress than those who were not. The data were analysed using traditional multiple regression techniques which recognised only the individual children as the units of analysis and ignored their groupings within teachers and into classes. The results were statistically significant. Subsequently, Aitkin et al, (1981) demonstrated that when the analysis accounted properly for the grouping of children into classes, the significant differences disappeared and the 'formally' taught children could not be shown to differ from the others.

... In essence what was occurring here was that the children within any one classroom, because they were taught together, tended to be similar in their performance. As a result they provide rather less information than would have been the case if the

same number of students had been taught separately by different teachers. In other words, the basic unit for purposes of comparison should have been the teacher not the student. The function of the students can be seen as providing, for each teacher, an estimate of that teacher's effectiveness. Increasing the number of students per teacher would increase the precision of those estimates but not change the number of teachers being compared. Beyond a certain point, simply increasing the numbers of students in this way hardly improves things at all. ...

Researchers have long recognised this issue. In education, for example, there has been much debate ... about the so called 'unit of analysis' problem, which is the one just outlined. Before multilevel modelling became well developed as a research tool, the problems of ignoring hierarchical structures were reasonably well understood, but they were difficult to solve because powerful general purpose tools were unavailable.

Models 1 and 3 (and the studies below by Cavalluzzo, by Goldhaber and Anthony, and by Vandervoort, et al.) use the traditional multiple regression approach, so that their conclusions are vulnerable to the same interpretation problem as outlined by Dr. Goldstein. Models 2 and 4, by properly accounting for the nested structure of the data, produce more defensible results.

The current study stands in contrast to other recent studies which reported that NBCTs are more likely to produce higher levels of student achievement than teachers who are not certified by the National Board. These studies include:

- Goldhaber and Anthony (March 2004). This study measured the effectiveness of NBCTs by studying the annual test scores of North Carolina students in grades three, four and five from three academic years: 1996-97, 1997-98 and 1998-99. The study found that students of NBCTs experienced year-end testing improvements that averaged 7 percent to 15 percent more than peers whose teachers were not NBCTs.
- Cavalluzzo (2004) at the CNA Corporation found that students of NBCTs did a measurably better job than other ninth and tenth graders on year-end math tests, conditional on their previous year score, in Miami-Dade County (Fla.) Public Schools.
- Vandervoort, Amrein-Beardsley, and Berliner (2004), at Arizona State University, found that students of NBCTs outperformed students of non-NBCTs on the Stanford-9 achievement test, with learning gains equivalent on average to spending more than an extra month in school each year.

Since none of these studies properly accounted for the nested structure of the data, their results are open to question. Caution is advised against too much reliance on the conclusions which have been drawn from these reports until analyses are completed which use the

appropriate sampling unit (i.e., teachers within certification status) as part of the error term to test the hypotheses of differences among NBPTS certification status classes. Additionally, it should be of interest to learn if the variability among individual teachers within a certification class is as large as indicated in the current study.

It is worth noting that the current study, and the other studies of the effectiveness of NBPTS Certification cited above, use student achievement scores as the outcome measure. That is, these studies make the implicit assumption that growth in student achievement is an appropriate indicator of teacher effectiveness. Using this indicator, the current study explicitly shows (and the small effect sizes in earlier studies suggest that the same is true in those cases) that the current NBPTS certification process does a relatively poor job of distinguishing effective from ineffective teachers. If growth in student achievement is indeed an appropriate standard of teacher effectiveness, it follows that including student growth measures in the certification process would vastly improve its ability to identify quality teachers.

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Table 1. Number of Teacher-Years and Student-Years used in the Analyses

| | | Certification Status | | | | | | | | All | |
|----------------|----------|----------------------|---------|--------------|---------|------------------------|---------|----------------|---------|------|-------|
| | | Certified Teacher | | Failed NBPTS | | Future NBPTS Candidate | | Never in NBPTS | | | |
| | | Tch Yrs | Stu Yrs | Tch Yrs | Stu Yrs | Tch Yrs | Stu Yrs | Tch Yrs | Stu Yrs | | |
| Subject | Grade | | | | | | | | | | |
| Math | 4 | 104 | 2152 | 46 | 939 | 92 | 1882 | 1616 | 32241 | 1858 | 37214 |
| | 5 | 122 | 2592 | 37 | 775 | 123 | 2735 | 1516 | 30613 | 1798 | 36715 |
| | 6 | 19 | 1217 | 14 | 861 | 19 | 1337 | 348 | 20797 | 400 | 24212 |
| | 7 | 13 | 929 | 11 | 829 | 17 | 1462 | 212 | 13257 | 253 | 16477 |
| | 8 | 23 | 1834 | 9 | 736 | 26 | 2039 | 242 | 15510 | 300 | 20119 |
| Reading | 4 | 104 | 2152 | 46 | 939 | 92 | 1882 | 1616 | 32241 | 1858 | 37214 |
| | 5 | 122 | 2592 | 37 | 775 | 123 | 2735 | 1516 | 30613 | 1798 | 36715 |
| | 6 | 32 | 2210 | 10 | 685 | 14 | 967 | 350 | 19638 | 406 | 23500 |
| | 7 | 25 | 1925 | 9 | 773 | 8 | 705 | 223 | 13361 | 265 | 16764 |
| | 8 | 23 | 1737 | 5 | 405 | 16 | 1197 | 253 | 16500 | 297 | 19839 |

Table 2 Summary of Comparisons Between NBPTS Certified Teachers and Others Combined Data from Charlotte-Mecklenberg and Wake County

| | | Math | | | | Reading | | | |
|-------|-------------------------------|-------|----|----|----|---------|----|----|----|
| | | Model | | | | Model | | | |
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| Grade | Comparison | | | | | | | | |
| 4 | Certified vs Failed NBPTS | + | ns | ns | ns | ns | ns | ns | ns |
| | Certified vs Future Candidate | ++ | ns | + | ns | ns | ns | ns | ns |
| | Certified vs Never in NBPTS | ns | ns | ns | ns | ns | ns | ns | ns |
| 5 | Certified vs Failed NBPTS | + | ns | + | ns | ns | ns | ns | ns |
| | Certified vs Future Candidate | ++ | + | ++ | + | ns | ns | ns | ns |
| | Certified vs Never in NBPTS | ++ | ns | ++ | ns | ++ | + | ns | ns |
| 6 | Certified vs Failed NBPTS | ++ | ns | + | ns | + | ns | ns | ns |
| | Certified vs Future Candidate | ++ | ns | ns | ns | ns | ns | ns | ns |
| | Certified vs Never in NBPTS | ++ | ns | ns | ns | ++ | ++ | ns | ns |
| 7 | Certified vs Failed NBPTS | ns | ns | ns | ns | - | ns | ns | ns |
| | Certified vs Future Candidate | ns | ns | ns | ns | ns | ns | ns | ns |
| | Certified vs Never in NBPTS | ns | ns | + | ns | ns | ns | -- | - |
| 8 | Certified vs Failed NBPTS | ++ | ns | ++ | ns | ns | ns | ++ | ns |
| | Certified vs Future Candidate | ns | ns | ns | ns | ns | ns | ns | ns |
| | Certified vs Never in NBPTS | ns | ns | + | ns | ns | ++ | ns | ns |

++ indicates that the NBPTS Certified Teacher estimate is significantly larger than the other, with p-value<.01.
 + indicates that the NBPTS Certified Teacher estimate is significantly larger than the other, with .01<=p-value<.05.
 -- indicates that the NBPTS Certified Teacher estimate is significantly smaller than the other, with p-value<.01.
 - indicates that the NBPTS Certified Teacher estimate is significantly smaller than the other, with .01<=p-value<.05.
 ns indicates that the NBPTS Certified Teacher estimate is not significantly different from the other.

Table 3A. Comparisons and Effects Sizes for Model 1

| Subject | Grade | Comparison | Estimate | Residual Variance | Effect Size |
|----------------|--------------|-------------------|-----------------|--------------------------|--------------------|
| Math | 4 | Cert vs Failed | 0.34 * | 19.04 | 0.08 |
| Math | 4 | Cert vs Future | 0.46 ** | 19.04 | 0.10 |
| Math | 4 | Cert vs Never | 0.19 | 19.04 | 0.04 |
| Math | 5 | Cert vs Failed | 0.44 * | 23.56 | 0.09 |
| Math | 5 | Cert vs Future | 0.74 ** | 23.56 | 0.15 |
| Math | 5 | Cert vs Never | 0.36 ** | 23.56 | 0.07 |
| Math | 6 | Cert vs Failed | 0.99 ** | 20.26 | 0.22 |
| Math | 6 | Cert vs Future | 0.54 ** | 20.26 | 0.12 |
| Math | 6 | Cert vs Never | 0.56 ** | 20.26 | 0.12 |
| Math | 7 | Cert vs Failed | 0.00 | 24.85 | 0.00 |
| Math | 7 | Cert vs Future | 0.09 | 24.85 | 0.02 |
| Math | 7 | Cert vs Never | 0.34 | 24.85 | 0.07 |
| Math | 8 | Cert vs Failed | 1.37 ** | 24.17 | 0.28 |
| Math | 8 | Cert vs Future | -0.07 | 24.17 | -0.01 |
| Math | 8 | Cert vs Never | 0.24 | 24.17 | 0.05 |
| Reading | 4 | Cert vs Failed | 0.27 | 26.26 | 0.05 |
| Reading | 4 | Cert vs Future | 0.17 | 26.26 | 0.03 |
| Reading | 4 | Cert vs Never | 0.02 | 26.26 | 0.00 |
| Reading | 5 | Cert vs Failed | 0.26 | 23.21 | 0.05 |
| Reading | 5 | Cert vs Future | 0.06 | 23.21 | 0.01 |
| Reading | 5 | Cert vs Never | 0.28 ** | 23.21 | 0.06 |
| Reading | 6 | Cert vs Failed | 0.50 * | 26.56 | 0.10 |
| Reading | 6 | Cert vs Future | 0.35 | 26.56 | 0.07 |
| Reading | 6 | Cert vs Never | 0.60 ** | 26.56 | 0.12 |
| Reading | 7 | Cert vs Failed | -0.42 * | 23.22 | -0.09 |
| Reading | 7 | Cert vs Future | 0.21 | 23.22 | 0.04 |
| Reading | 7 | Cert vs Never | -0.11 | 23.22 | -0.02 |
| Reading | 8 | Cert vs Failed | 0.40 | 23.29 | 0.08 |
| Reading | 8 | Cert vs Future | 0.28 | 23.29 | 0.06 |
| Reading | 8 | Cert vs Never | 0.11 | 23.29 | 0.02 |

Table 3B. Comparisons and Effects Sizes for Model 2

| Subject | Grade | Comparison | Estimate | Residual Variance | Effect Size |
|----------------|--------------|-------------------|-----------------|--------------------------|--------------------|
| Math | 4 | Cert vs Failed | 0.22 | 17.03 | 0.05 |
| Math | 4 | Cert vs Future | 0.22 | 17.03 | 0.05 |
| Math | 4 | Cert vs Never | 0.05 | 17.03 | 0.01 |
| Math | 5 | Cert vs Failed | 0.46 | 20.83 | 0.10 |
| Math | 5 | Cert vs Future | 0.64 * | 20.83 | 0.14 |
| Math | 5 | Cert vs Never | 0.32 | 20.83 | 0.07 |
| Math | 6 | Cert vs Failed | 0.59 | 17.73 | 0.14 |
| Math | 6 | Cert vs Future | 0.07 | 17.73 | 0.02 |
| Math | 6 | Cert vs Never | 0.27 | 17.73 | 0.06 |
| Math | 7 | Cert vs Failed | 0.23 | 22.34 | 0.05 |
| Math | 7 | Cert vs Future | 0.44 | 22.34 | 0.09 |
| Math | 7 | Cert vs Never | 0.40 | 22.34 | 0.08 |
| Math | 8 | Cert vs Failed | 0.82 | 22.01 | 0.17 |
| Math | 8 | Cert vs Future | -0.20 | 22.01 | -0.04 |
| Math | 8 | Cert vs Never | 0.24 | 22.01 | 0.05 |
| Reading | 4 | Cert vs Failed | 0.17 | 25.31 | 0.03 |
| Reading | 4 | Cert vs Future | 0.06 | 25.31 | 0.01 |
| Reading | 4 | Cert vs Never | -0.02 | 25.31 | -0.00 |
| Reading | 5 | Cert vs Failed | 0.27 | 22.41 | 0.06 |
| Reading | 5 | Cert vs Future | 0.06 | 22.41 | 0.01 |
| Reading | 5 | Cert vs Never | 0.32 * | 22.41 | 0.07 |
| Reading | 6 | Cert vs Failed | 0.46 | 25.96 | 0.09 |
| Reading | 6 | Cert vs Future | 0.12 | 25.96 | 0.02 |
| Reading | 6 | Cert vs Never | 0.58 ** | 25.96 | 0.11 |
| Reading | 7 | Cert vs Failed | -0.49 | 22.51 | -0.10 |
| Reading | 7 | Cert vs Future | 0.15 | 22.51 | 0.03 |
| Reading | 7 | Cert vs Never | 0.05 | 22.51 | 0.01 |
| Reading | 8 | Cert vs Failed | 0.36 | 22.66 | 0.08 |
| Reading | 8 | Cert vs Future | 0.37 | 22.66 | 0.08 |
| Reading | 8 | Cert vs Never | 0.49 ** | 22.66 | 0.10 |

Table 3C. Comparisons and Effects Sizes for Model 3

| Subject | Grade | Comparison | Estimate | Residual Variance | Effect Size |
|----------------|--------------|-------------------|-----------------|--------------------------|--------------------|
| Math | 4 | Cert vs Failed | 0.26 | 21.95 | 0.05 |
| Math | 4 | Cert vs Future | 0.33 * | 21.95 | 0.07 |
| Math | 4 | Cert vs Never | 0.11 | 21.95 | 0.02 |
| Math | 5 | Cert vs Failed | 0.46 * | 25.82 | 0.09 |
| Math | 5 | Cert vs Future | 0.74 ** | 25.82 | 0.15 |
| Math | 5 | Cert vs Never | 0.34 ** | 25.82 | 0.07 |
| Math | 6 | Cert vs Failed | 0.49 * | 24.58 | 0.10 |
| Math | 6 | Cert vs Future | 0.04 | 24.58 | 0.01 |
| Math | 6 | Cert vs Never | -0.01 | 24.58 | -0.00 |
| Math | 7 | Cert vs Failed | -0.13 | 26.28 | -0.03 |
| Math | 7 | Cert vs Future | 0.22 | 26.28 | 0.04 |
| Math | 7 | Cert vs Never | 0.46 * | 26.28 | 0.09 |
| Math | 8 | Cert vs Failed | 1.09 ** | 29.60 | 0.20 |
| Math | 8 | Cert vs Future | -0.01 | 29.60 | -0.00 |
| Math | 8 | Cert vs Never | 0.30 * | 29.60 | 0.05 |
| Reading | 4 | Cert vs Failed | 0.06 | 34.52 | 0.01 |
| Reading | 4 | Cert vs Future | -0.13 | 34.52 | -0.02 |
| Reading | 4 | Cert vs Never | -0.24 | 34.52 | -0.04 |
| Reading | 5 | Cert vs Failed | 0.29 | 31.36 | 0.05 |
| Reading | 5 | Cert vs Future | 0.07 | 31.36 | 0.01 |
| Reading | 5 | Cert vs Never | 0.13 | 31.36 | 0.02 |
| Reading | 6 | Cert vs Failed | 0.51 | 33.66 | 0.09 |
| Reading | 6 | Cert vs Future | -0.20 | 33.66 | -0.03 |
| Reading | 6 | Cert vs Never | 0.22 | 33.66 | 0.04 |
| Reading | 7 | Cert vs Failed | -0.28 | 39.46 | -0.05 |
| Reading | 7 | Cert vs Future | 0.22 | 39.46 | 0.04 |
| Reading | 7 | Cert vs Never | -0.46 ** | 39.46 | -0.07 |
| Reading | 8 | Cert vs Failed | 1.39 ** | 35.86 | 0.23 |
| Reading | 8 | Cert vs Future | 0.13 | 35.86 | 0.02 |
| Reading | 8 | Cert vs Never | -0.31 | 35.86 | -0.05 |

Table 3D. Comparisons and Effects Sizes for Model 4

| Subject | Grade | Comparison | Estimate | Residual Variance | Effect Size |
|----------------|--------------|-------------------|-----------------|--------------------------|--------------------|
| Math | 4 | Cert vs Failed | 0.16 | 19.92 | 0.04 |
| Math | 4 | Cert vs Future | 0.14 | 19.92 | 0.03 |
| Math | 4 | Cert vs Never | -0.01 | 19.92 | -0.00 |
| Math | 5 | Cert vs Failed | 0.53 | 23.05 | 0.11 |
| Math | 5 | Cert vs Future | 0.70 * | 23.05 | 0.15 |
| Math | 5 | Cert vs Never | 0.29 | 23.05 | 0.06 |
| Math | 6 | Cert vs Failed | 0.28 | 21.95 | 0.06 |
| Math | 6 | Cert vs Future | -0.30 | 21.95 | -0.06 |
| Math | 6 | Cert vs Never | -0.47 | 21.95 | -0.10 |
| Math | 7 | Cert vs Failed | 0.13 | 23.87 | 0.03 |
| Math | 7 | Cert vs Future | 0.56 | 23.87 | 0.12 |
| Math | 7 | Cert vs Never | 0.56 | 23.87 | 0.12 |
| Math | 8 | Cert vs Failed | 0.54 | 27.15 | 0.10 |
| Math | 8 | Cert vs Future | 0.16 | 27.15 | 0.03 |
| Math | 8 | Cert vs Never | 0.05 | 27.15 | 0.01 |
| Reading | 4 | Cert vs Failed | 0.03 | 33.65 | 0.01 |
| Reading | 4 | Cert vs Future | -0.15 | 33.65 | -0.03 |
| Reading | 4 | Cert vs Never | -0.22 | 33.65 | -0.04 |
| Reading | 5 | Cert vs Failed | 0.31 | 30.44 | 0.06 |
| Reading | 5 | Cert vs Future | 0.03 | 30.44 | 0.01 |
| Reading | 5 | Cert vs Never | 0.09 | 30.44 | 0.02 |
| Reading | 6 | Cert vs Failed | 0.44 | 32.64 | 0.08 |
| Reading | 6 | Cert vs Future | -0.44 | 32.64 | -0.08 |
| Reading | 6 | Cert vs Never | -0.04 | 32.64 | -0.01 |
| Reading | 7 | Cert vs Failed | -0.49 | 37.86 | -0.08 |
| Reading | 7 | Cert vs Future | 0.10 | 37.86 | 0.02 |
| Reading | 7 | Cert vs Never | -0.75 * | 37.86 | -0.12 |
| Reading | 8 | Cert vs Failed | 1.42 | 35.03 | 0.24 |
| Reading | 8 | Cert vs Future | 0.34 | 35.03 | 0.06 |
| Reading | 8 | Cert vs Never | -0.24 | 35.03 | -0.04 |

Figure 1. Model 2 Teacher Effects for 4th Grade Math

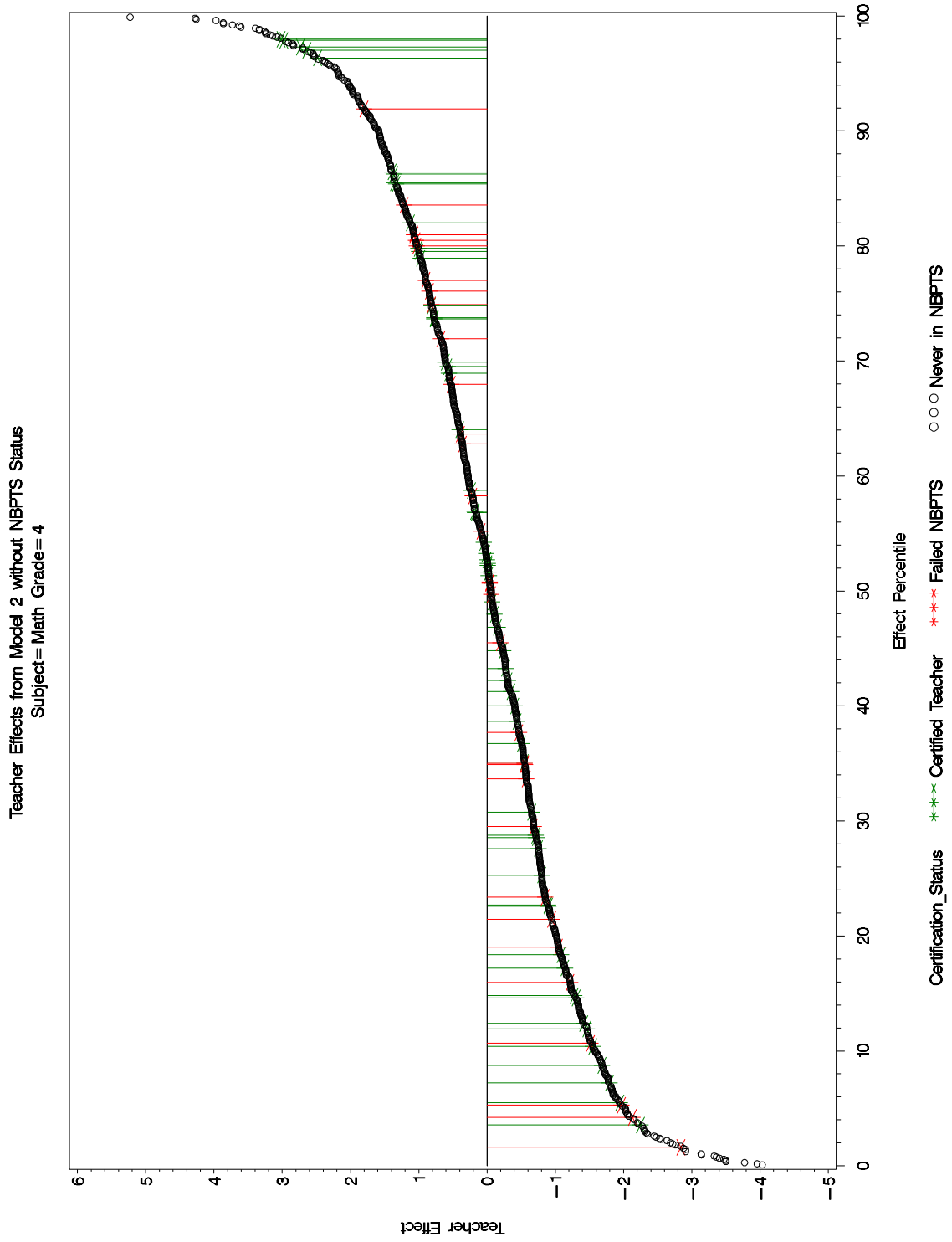


Figure 2. Model 2 Teacher Effects for 5th Grade Math

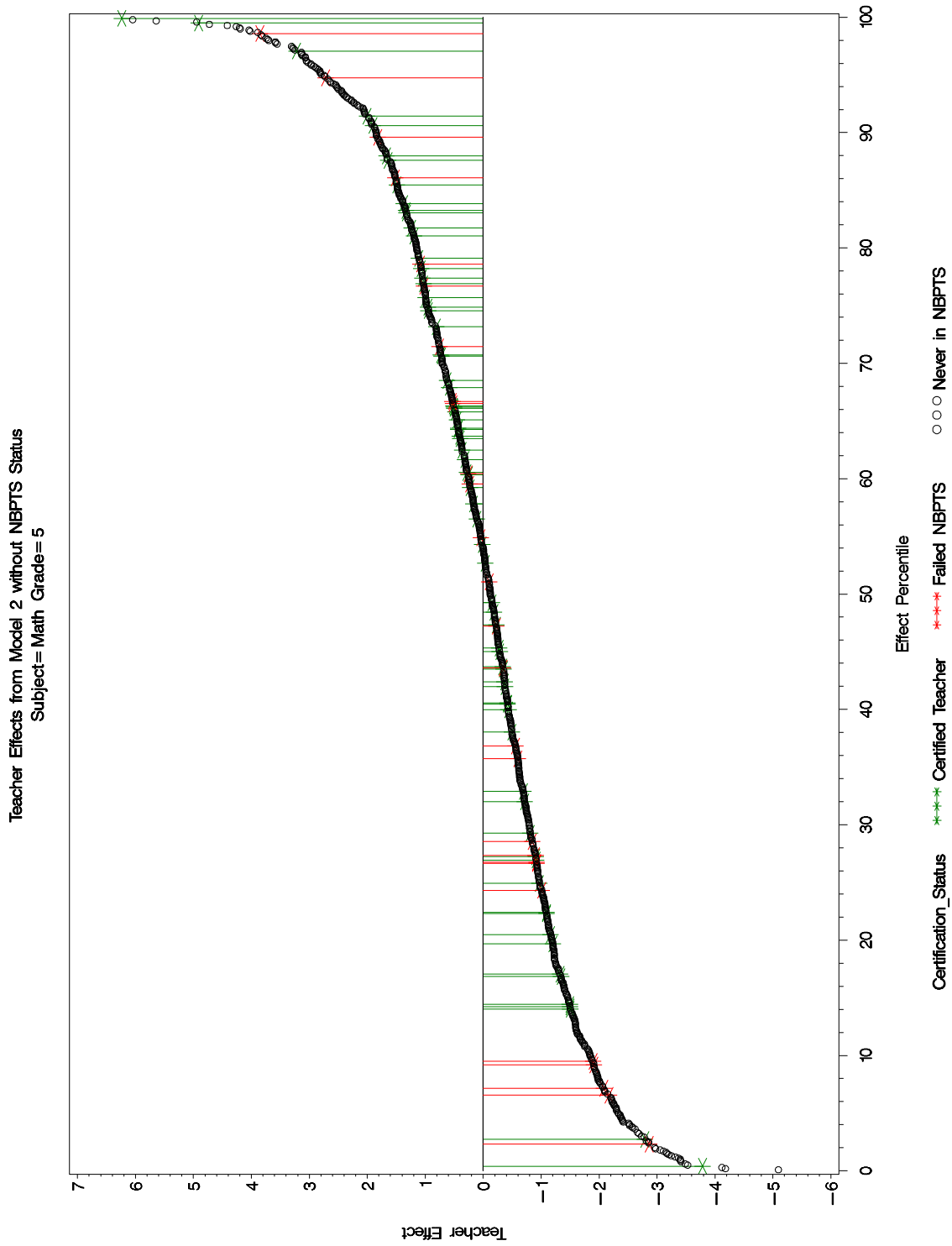


Figure 3. Model 2 Teacher Effects for 6th Grade Math

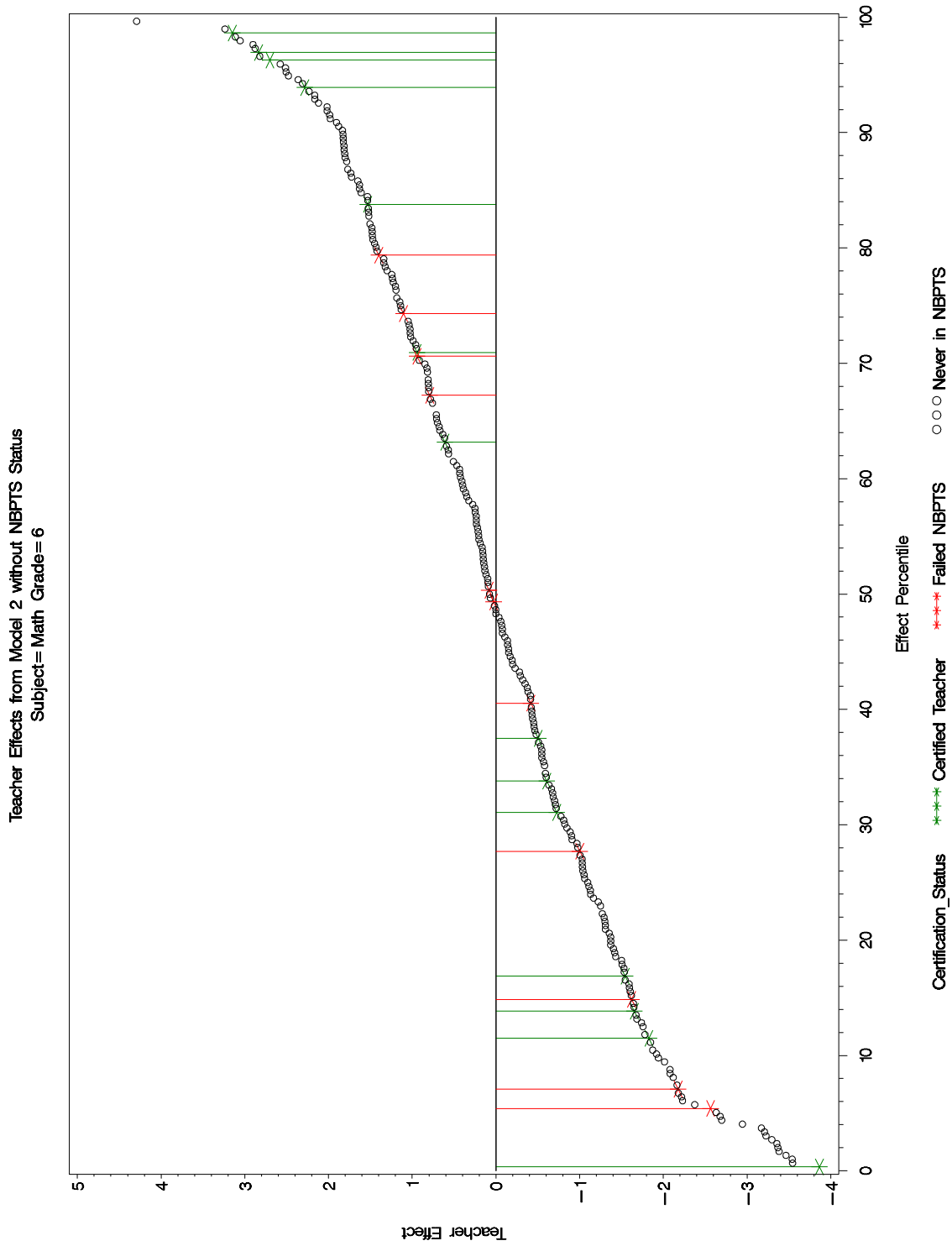


Figure 4. Model 2 Teacher Effects for 7th Grade Math

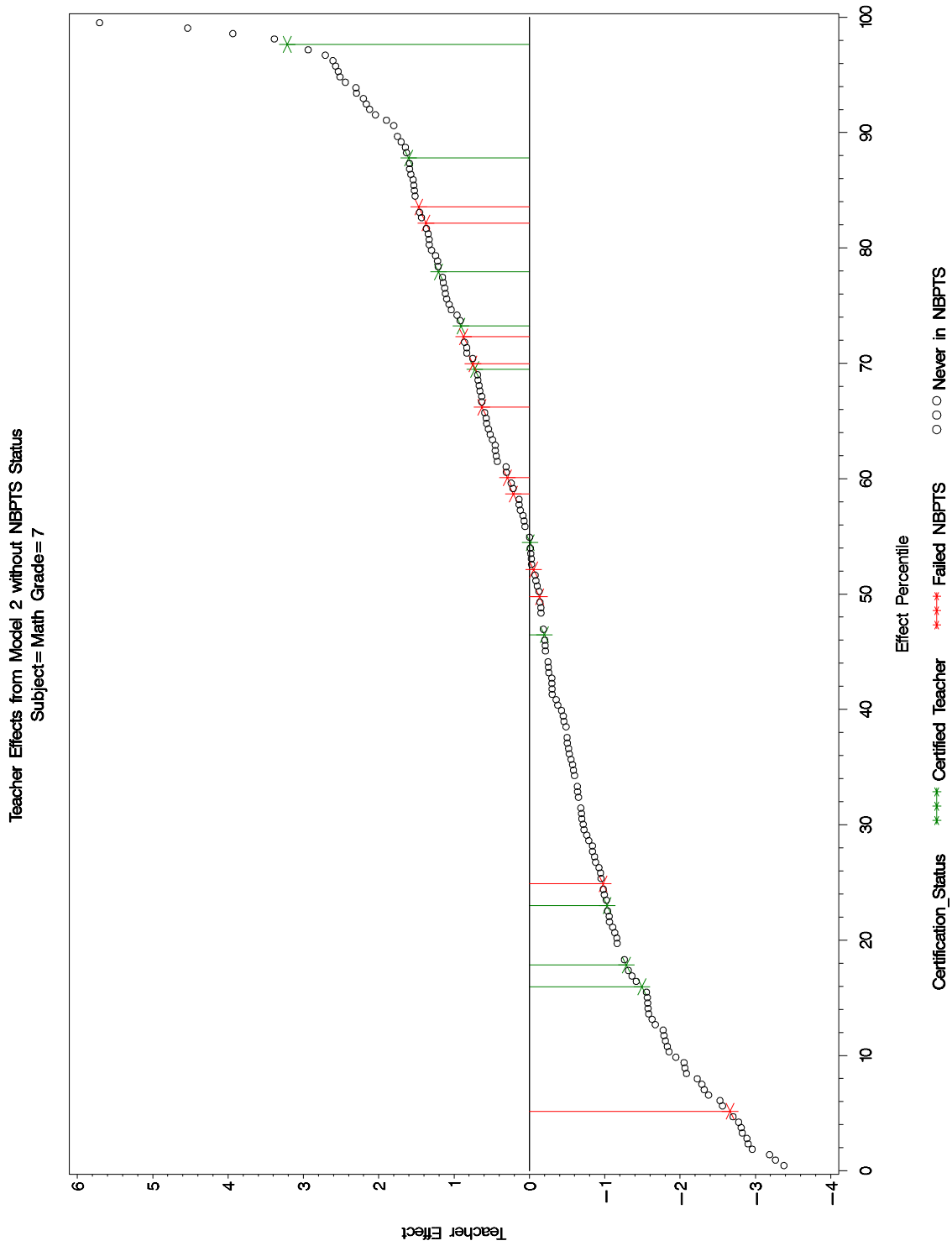


Figure 5. Model 2 Teacher Effects for 8th Grade Math

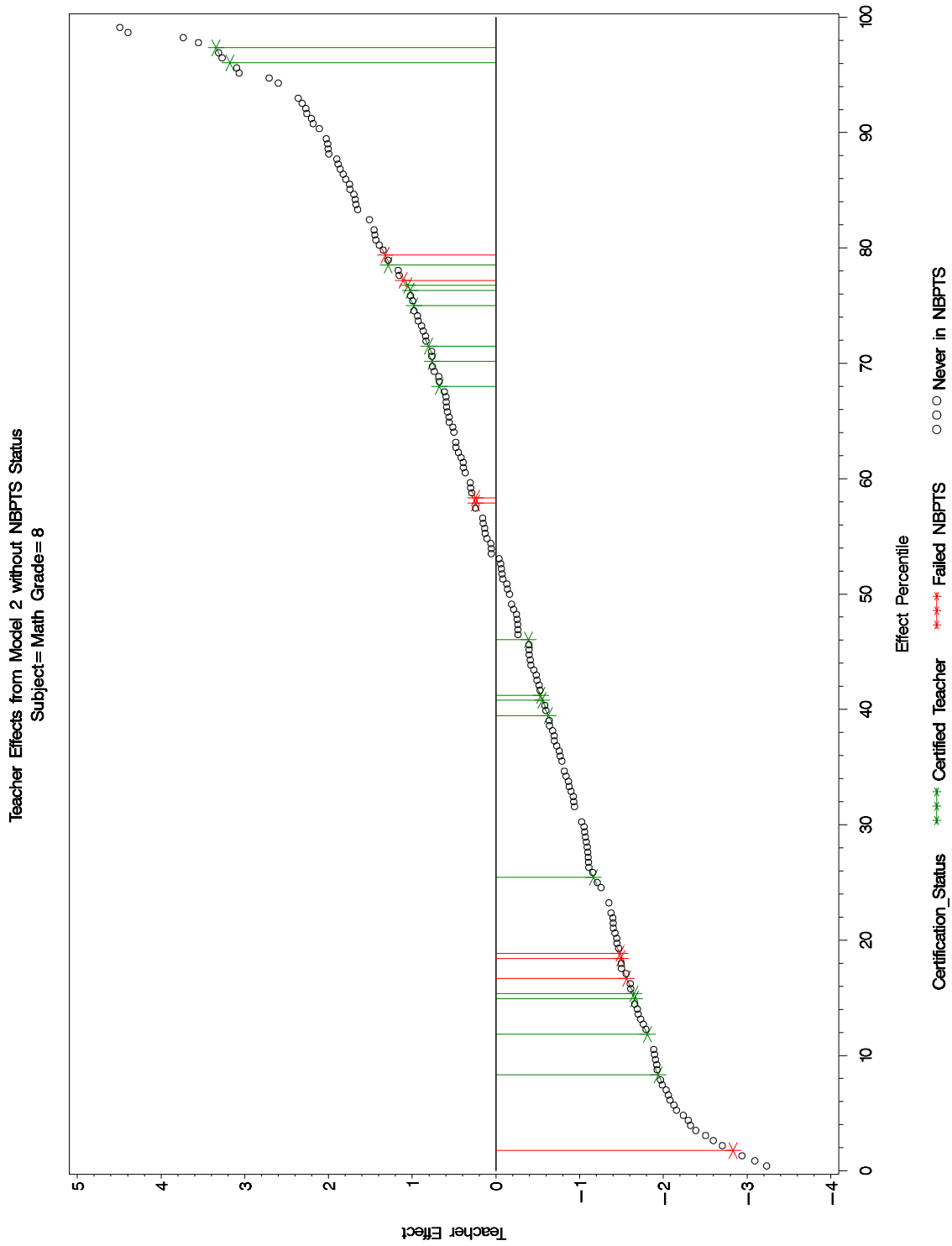


Figure 6. Model 2 Teacher Effects for 4th Grade Reading

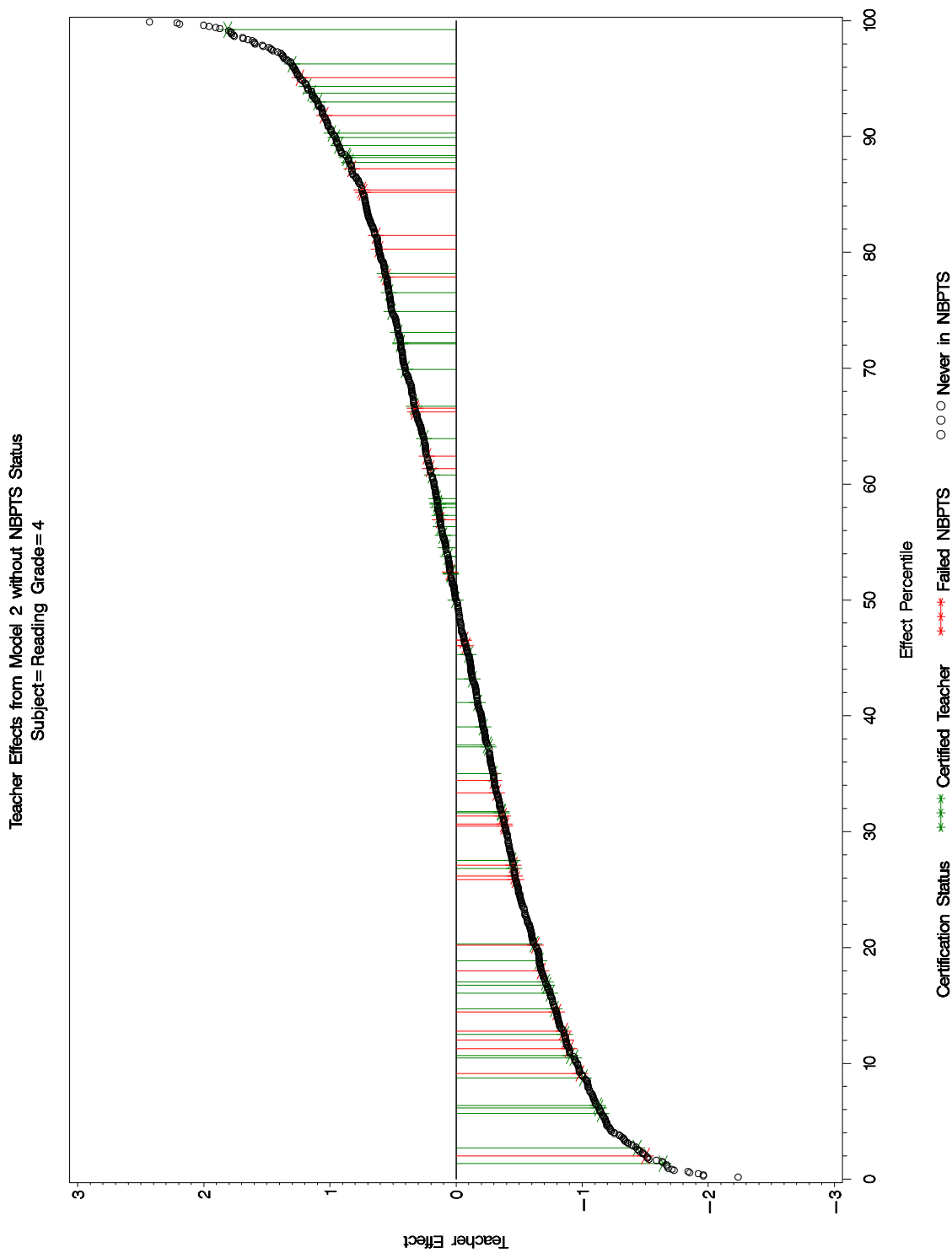


Figure 7. Model 2 Teacher Effects for 5th Grade Reading

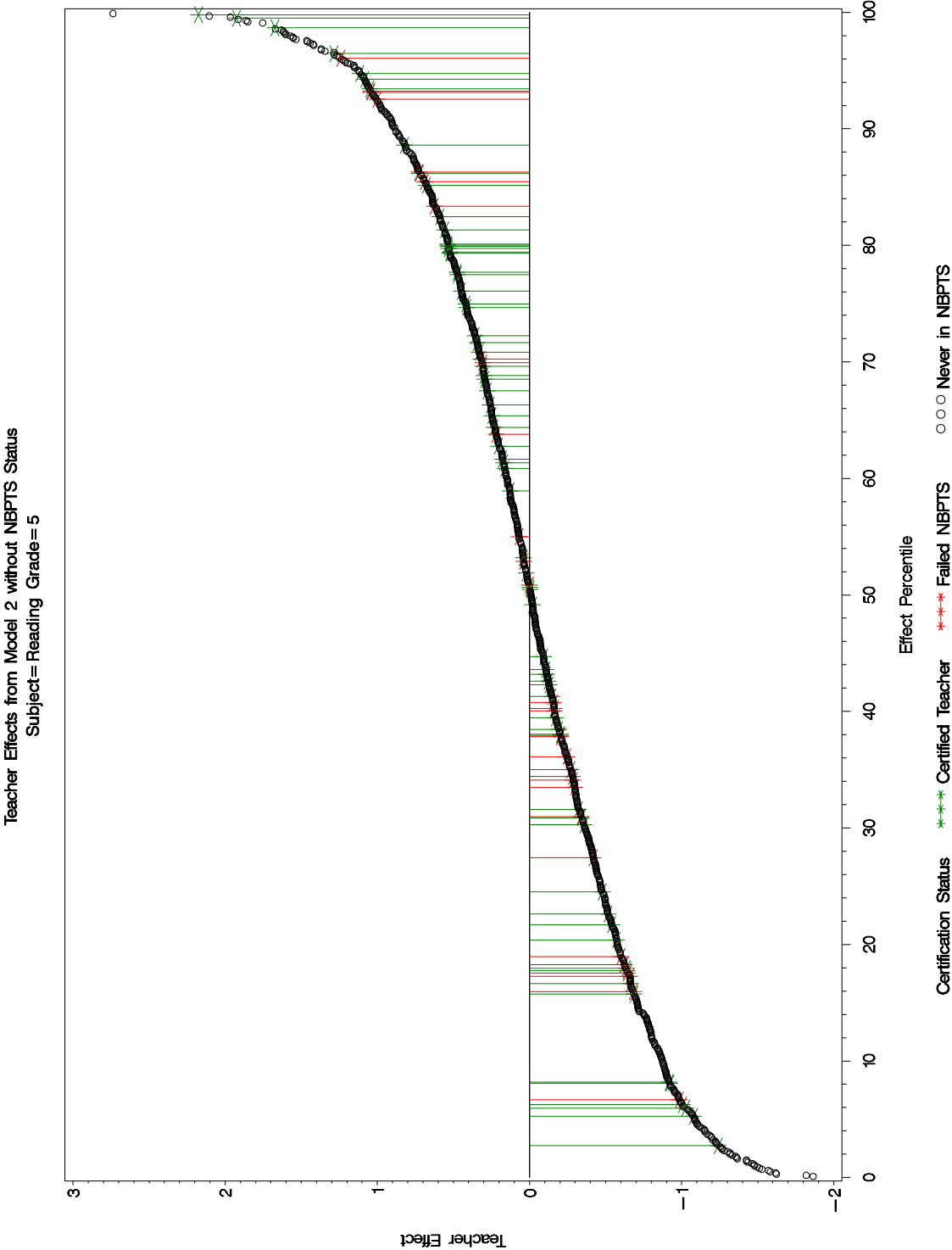


Figure 8. Model 2 Teacher Effects for 6th Grade Reading

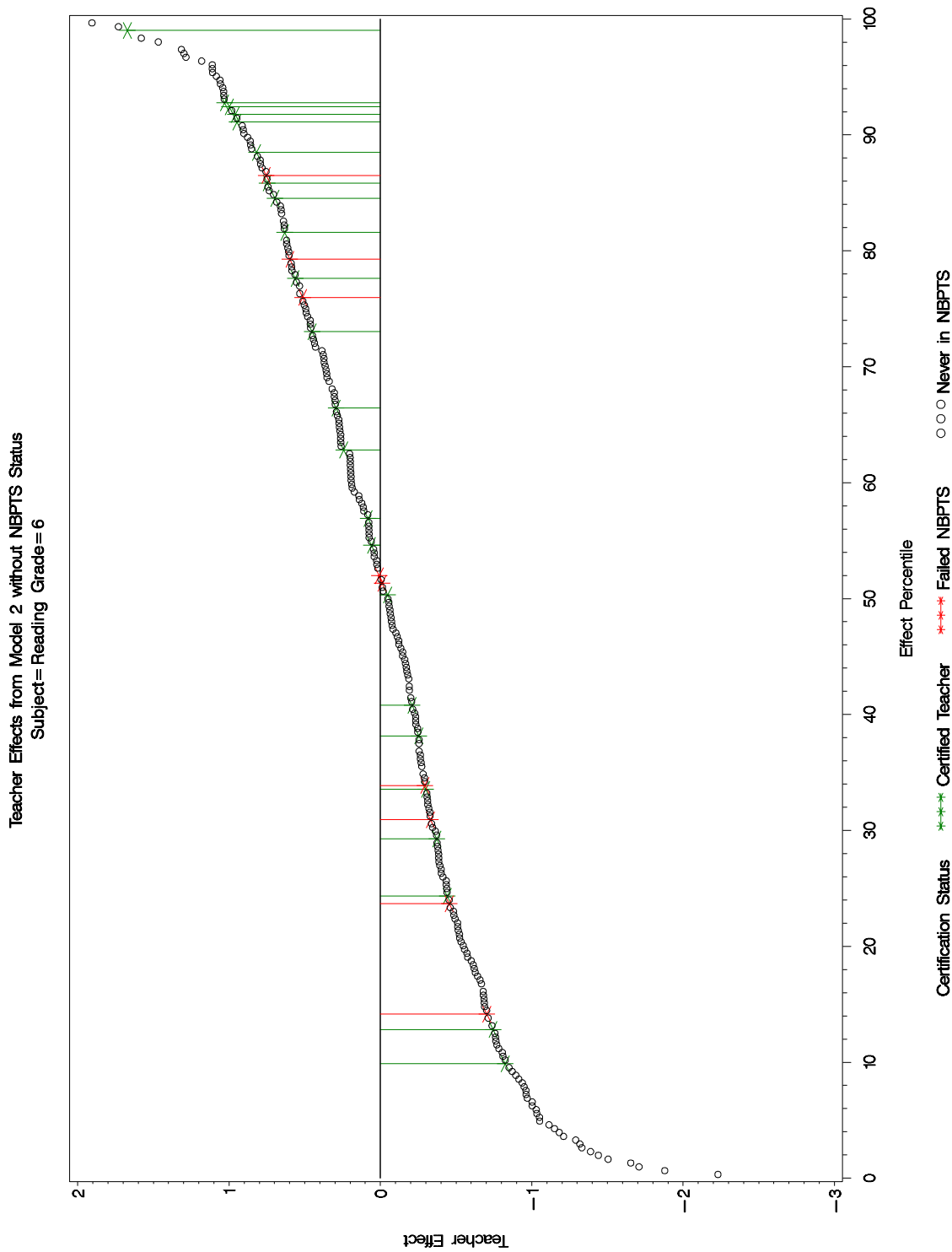


Figure 9. Model 2 Teacher Effects for 7th Grade Reading

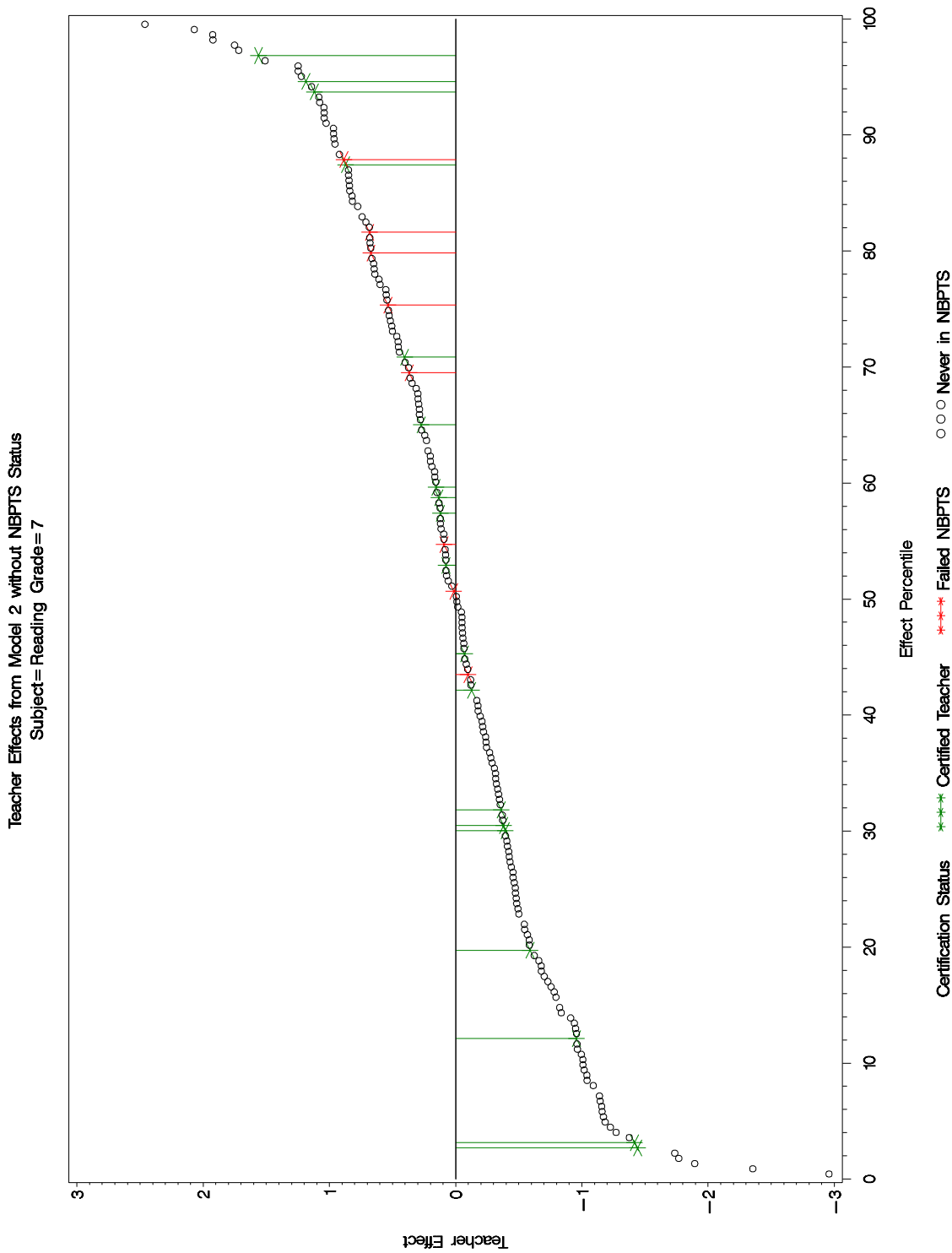


Figure 10. Model 2 Teacher Effects for 8th Grade Reading

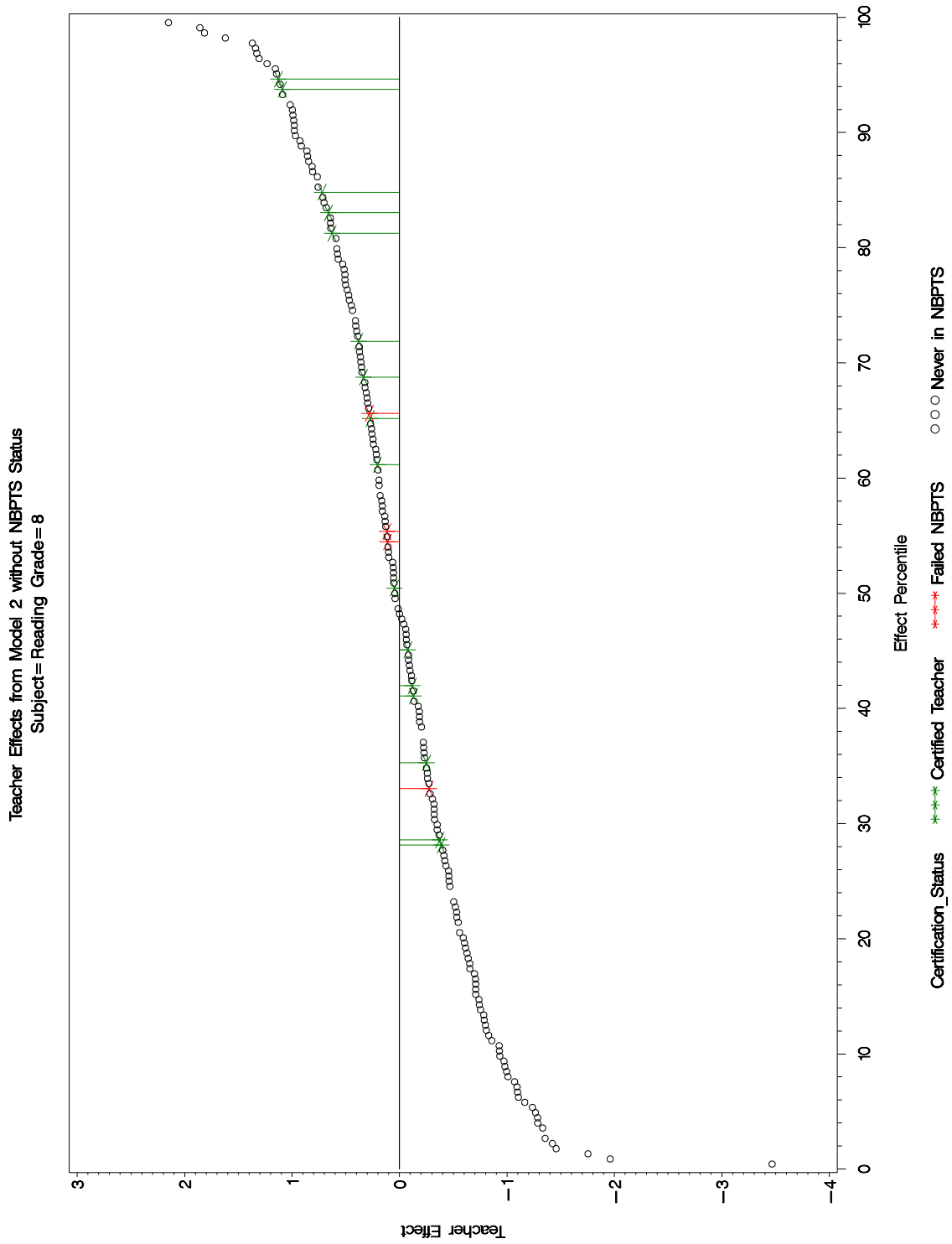


Table A.1 Analysis Results for 4th Grade Mathematics

| Effect | Response Variable=Scale Score | | | | | | | | Response Variable=Simple Scale Score Gain | | | | | | | |
|-------------------------------------|-------------------------------|--------|---------|---------|--|--------|---------|---------|---|--------|---------|---------|--|--------|---------|---------|
| | Model 1 | | | | Model 2 | | | | Model 3 | | | | Model 4 | | | |
| | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | |
| Effect | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value |
| Certification Status | 3 | 37184 | 3.89 | ** | 3 | 1035 | 0.34 | ns | 3 | 37192 | 1.95 | ns | 3 | 1035 | 0.26 | ns |
| Gender of Student | 1 | 37184 | 43.70 | ** | 1 | 36149 | 48.74 | ** | 1 | 37192 | 1.03 | ns | 1 | 36157 | 1.07 | ns |
| Prev Math Score(Year) | 4 | 37184 | 5018.34 | ** | 4 | 36149 | 5304.73 | ** | | | | | | | | |
| Prev Read Score(Year) | 4 | 37184 | 596.60 | ** | 4 | 36149 | 628.31 | ** | | | | | | | | |
| Race of Student | 5 | 37184 | 139.17 | ** | 5 | 36149 | 147.76 | ** | 5 | 37192 | 29.82 | ** | 5 | 36157 | 33.43 | ** |
| Teacher Years Experience | 9 | 37184 | 13.59 | ** | 9 | 36149 | 8.05 | ** | 9 | 37192 | 8.29 | ** | 9 | 36157 | 6.07 | ** |
| Year of Student Test | 3 | 37184 | 249.10 | ** | 3 | 36149 | 251.72 | ** | 3 | 37192 | 394.98 | ** | 3 | 36157 | 309.15 | ** |
| | | | | | | | | | | | | | | | | |
| Comparisons | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value |
| Certified vs Failed NBPTS | 0.34 | 0.17 | 2.00 | * | 0.22 | 0.32 | 0.68 | ns | 0.26 | 0.18 | 1.40 | ns | 0.16 | 0.32 | 0.50 | ns |
| Certified vs Future NBPTS Candidate | 0.46 | 0.14 | 3.22 | ** | 0.22 | 0.30 | 0.71 | ns | 0.33 | 0.15 | 2.15 | * | 0.14 | 0.31 | 0.46 | ns |
| Certified vs Never in NBPTS | 0.19 | 0.10 | 1.89 | ns | 0.05 | 0.21 | 0.22 | ns | 0.11 | 0.11 | 1.00 | ns | -0.01 | 0.22 | -0.03 | ns |
| | | | | | | | | | | | | | | | | |
| Variance Component Estimates | Estimate | | | | Estimate | | | | Estimate | | | | Estimate | | | |
| Certified Teacher | | | | | 1.82 | | | | | | | | 1.84 | | | |
| Failed NBPTS | | | | | 1.32 | | | | | | | | 1.23 | | | |
| Future NBPTS Candidate | | | | | 2.70 | | | | | | | | 2.57 | | | |
| Never in NBPTS | | | | | 2.19 | | | | | | | | 2.25 | | | |
| Residual | 19.04 | | | | 17.03 | | | | 21.95 | | | | 19.92 | | | |

* indicates statistical significance at the 0.05 level; ** indicates statistical significance at the 0.01 level; ns means not significant.

Table A.2 Analysis Results for 5th Grade Mathematics

| Effect | Response Variable=Scale Score | | | | | | | | Response Variable=Simple Scale Score Gain | | | | | | | |
|-------------------------------------|-------------------------------|--------|---------|---------|--|--------|---------|---------|---|--------|---------|---------|--|--------|---------|---------|
| | Model 1 | | | | Model 2 | | | | Model 3 | | | | Model 4 | | | |
| | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | |
| Effect | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value |
| Certification Status | 3 | 36685 | 9.84 | ** | 3 | 986 | 1.48 | ns | 3 | 36693 | 9.10 | ** | 3 | 986 | 1.68 | ns |
| Gender of Student | 1 | 36685 | 11.04 | ** | 1 | 35699 | 16.19 | ** | 1 | 36693 | 4.62 | * | 1 | 35707 | 3.15 | ns |
| Prev Math Score(Year) | 4 | 36685 | 6077.78 | ** | 4 | 35699 | 6472.12 | ** | | | | | | | | |
| Prev Read Score(Year) | 4 | 36685 | 504.72 | ** | 4 | 35699 | 521.64 | ** | | | | | | | | |
| Race of Student | 5 | 36685 | 117.76 | ** | 5 | 35699 | 107.74 | ** | 5 | 36693 | 65.41 | ** | 5 | 35707 | 50.13 | ** |
| Teacher Years Experience | 9 | 36685 | 7.10 | ** | 9 | 35699 | 1.94 | * | 9 | 36693 | 7.21 | ** | 9 | 35707 | 1.75 | ns |
| Year of Student Test | 3 | 36685 | 204.14 | ** | 3 | 35699 | 199.91 | ** | 3 | 36693 | 192.23 | ** | 3 | 35707 | 180.46 | ** |
| | | | | | | | | | | | | | | | | |
| Comparisons | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value |
| Certified vs Failed NBPTS | 0.44 | 0.20 | 2.19 | * | 0.46 | 0.43 | 1.07 | ns | 0.46 | 0.21 | 2.20 | * | 0.53 | 0.46 | 1.13 | ns |
| Certified vs Future NBPTS Candidate | 0.74 | 0.14 | 5.40 | ** | 0.64 | 0.31 | 2.06 | * | 0.74 | 0.14 | 5.15 | ** | 0.70 | 0.32 | 2.17 | * |
| Certified vs Never in NBPTS | 0.36 | 0.10 | 3.52 | ** | 0.32 | 0.22 | 1.43 | ns | 0.34 | 0.11 | 3.16 | ** | 0.29 | 0.23 | 1.24 | ns |
| | | | | | | | | | | | | | | | | |
| Variance Component Estimates | Estimate | | | | Estimate | | | | Estimate | | | | Estimate | | | |
| Certified Teacher | | | | | 2.44 | | | | | | | | 2.61 | | | |
| Failed NBPTS | | | | | 3.00 | | | | | | | | 3.68 | | | |
| Future NBPTS Candidate | | | | | 3.10 | | | | | | | | 3.46 | | | |
| Never in NBPTS | | | | | 2.89 | | | | | | | | 2.89 | | | |
| Residual | 23.56 | | | | 20.83 | | | | 25.82 | | | | 23.05 | | | |

* indicates statistical significance at the 0.05 level; ** indicates statistical significance at the 0.01 level; ns means not significant.

Table A.3 Analysis Results for 6th Grade Mathematics

| Effect | Response Variable=Scale Score | | | | | | | | Response Variable=Simple Scale Score Gain | | | | | | | |
|-------------------------------------|-------------------------------|--------|---------|---------|--|--------|---------|---------|---|--------|---------|---------|--|--------|---------|---------|
| | Model 1 | | | | Model 2 | | | | Model 3 | | | | Model 4 | | | |
| | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | |
| Effect | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value |
| Certification Status | 3 | 24188 | 8.69 | ** | 3 | 291 | 0.27 | ns | 3 | 24192 | 2.72 | * | 3 | 291 | 1.05 | ns |
| Gender of Student | 1 | 24188 | 4.74 | * | 1 | 23897 | 4.91 | * | 1 | 24192 | 1.28 | ns | 1 | 23901 | 2.30 | ns |
| Prev Math Score(Year) | 2 | 24188 | 10021.2 | ** | 2 | 23897 | 10217.5 | ** | | | | | | | | |
| Prev Read Score(Year) | 2 | 24188 | 511.12 | ** | 2 | 23897 | 540.90 | ** | | | | | | | | |
| Race of Student | 5 | 24188 | 82.96 | ** | 5 | 23897 | 73.40 | ** | 5 | 24192 | 26.00 | ** | 5 | 23901 | 15.86 | ** |
| Teacher Years Experience | 9 | 24188 | 11.08 | ** | 9 | 23897 | 3.27 | ** | 9 | 24192 | 7.79 | ** | 9 | 23901 | 3.87 | ** |
| Year of Student Test | 1 | 24188 | 174.51 | ** | 1 | 23897 | 154.30 | ** | 1 | 24192 | 0.25 | ns | 1 | 23901 | 0.06 | ns |
| | | | | | | | | | | | | | | | | |
| Comparisons | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value |
| Certified vs Failed NBPTS | 0.99 | 0.20 | 4.93 | ** | 0.59 | 0.78 | 0.76 | ns | 0.49 | 0.22 | 2.23 | * | 0.28 | 0.77 | 0.36 | ns |
| Certified vs Future NBPTS Candidate | 0.54 | 0.18 | 2.98 | ** | 0.07 | 0.80 | 0.08 | ns | 0.04 | 0.20 | 0.19 | ns | -0.30 | 0.80 | -0.38 | ns |
| Certified vs Never in NBPTS | 0.56 | 0.14 | 4.07 | ** | 0.27 | 0.64 | 0.43 | ns | -0.01 | 0.15 | -0.07 | ns | -0.47 | 0.66 | -0.72 | ns |
| | | | | | | | | | | | | | | | | |
| Variance Component Estimates | Estimate | | | | Estimate | | | | Estimate | | | | Estimate | | | |
| Certified Teacher | | | | | 5.10 | | | | | | | | 5.34 | | | |
| Failed NBPTS | | | | | 2.15 | | | | | | | | 1.56 | | | |
| Future NBPTS Candidate | | | | | 3.45 | | | | | | | | 2.95 | | | |
| Never in NBPTS | | | | | 2.53 | | | | | | | | 2.87 | | | |
| Residual | 20.26 | | | | 17.73 | | | | 24.58 | | | | 21.95 | | | |

* indicates statistical significance at the 0.05 level; ** indicates statistical significance at the 0.01 level; ns means not significant.

Table A.4 Analysis Results for 7th Grade Mathematics

| Effect | Response Variable=Scale Score | | | | | | | | Response Variable=Simple Scale Score Gain | | | | | | | |
|-------------------------------------|-------------------------------|--------|---------|---------|--|--------|---------|---------|---|--------|---------|---------|--|--------|---------|---------|
| | Model 1 | | | | Model 2 | | | | Model 3 | | | | Model 4 | | | |
| | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | |
| Effect | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value |
| Certification Status | 3 | 16453 | 2.46 | ns | 3 | 203 | 0.22 | ns | 3 | 16457 | 4.86 | ** | 3 | 203 | 0.58 | ns |
| Gender of Student | 1 | 16453 | 2.20 | ns | 1 | 16250 | 2.35 | ns | 1 | 16457 | 32.67 | ** | 1 | 16254 | 35.52 | ** |
| Prev Math Score(Year) | 2 | 16453 | 7639.82 | ** | 2 | 16250 | 7437.94 | ** | | | | | | | | |
| Prev Read Score(Year) | 2 | 16453 | 424.83 | ** | 2 | 16250 | 442.72 | ** | | | | | | | | |
| Race of Student | 5 | 16453 | 28.05 | ** | 5 | 16250 | 25.63 | ** | 5 | 16457 | 26.46 | ** | 5 | 16254 | 14.40 | ** |
| Teacher Years Experience | 9 | 16453 | 11.60 | ** | 9 | 16250 | 0.96 | ns | 9 | 16457 | 11.50 | ** | 9 | 16254 | 0.89 | ns |
| Year of Student Test | 1 | 16453 | 2.12 | ns | 1 | 16250 | 0.00 | ns | 1 | 16457 | 37.75 | ** | 1 | 16254 | 60.25 | ** |
| | | | | | | | | | | | | | | | | |
| Comparisons | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value |
| Certified vs Failed NBPTS | 0.00 | 0.25 | 0.02 | ns | 0.23 | 0.65 | 0.35 | ns | -0.13 | 0.25 | -0.53 | ns | 0.13 | 0.68 | 0.19 | ns |
| Certified vs Future NBPTS Candidate | 0.09 | 0.22 | 0.44 | ns | 0.44 | 0.61 | 0.72 | ns | 0.22 | 0.22 | 0.99 | ns | 0.56 | 0.63 | 0.89 | ns |
| Certified vs Never in NBPTS | 0.34 | 0.18 | 1.88 | ns | 0.40 | 0.56 | 0.71 | ns | 0.46 | 0.19 | 2.47 | * | 0.56 | 0.59 | 0.96 | ns |
| | | | | | | | | | | | | | | | | |
| Variance Component Estimates | Estimate | | | | Estimate | | | | Estimate | | | | Estimate | | | |
| Certified Teacher | | | | | 2.28 | | | | | | | | 2.54 | | | |
| Failed NBPTS | | | | | 1.27 | | | | | | | | 1.36 | | | |
| Future NBPTS Candidate | | | | | 0.83 | | | | | | | | 0.85 | | | |
| Never in NBPTS | | | | | 3.01 | | | | | | | | 2.77 | | | |
| Residual | 24.85 | | | | 22.34 | | | | 26.28 | | | | 23.87 | | | |

* indicates statistical significance at the 0.05 level; ** indicates statistical significance at the 0.01 level; ns means not significant.

Table A.5 Analysis Results for 8th Grade Mathematics

| Effect | Response Variable=Scale Score | | | | | | | | Response Variable=Simple Scale Score Gain | | | | | | | |
|-------------------------------------|-------------------------------|--------|---------|---------|--|--------|---------|---------|---|--------|---------|---------|--|--------|---------|---------|
| | Model 1 | | | | Model 2 | | | | Model 3 | | | | Model 4 | | | |
| | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | |
| Effect | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value |
| Certification Status | 3 | 20092 | 16.35 | ** | 3 | 221 | 0.66 | ns | 3 | 20098 | 8.52 | ** | 3 | 221 | 0.20 | ns |
| Gender of Student | 1 | 20092 | 29.03 | ** | 1 | 19871 | 28.95 | ** | 1 | 20098 | 0.94 | ns | 1 | 19877 | 0.17 | ns |
| Prev Math Score(Year) | 3 | 20092 | 6688.87 | ** | 3 | 19871 | 6466.84 | ** | | | | | | | | |
| Prev Read Score(Year) | 3 | 20092 | 290.89 | ** | 3 | 19871 | 288.69 | ** | | | | | | | | |
| Race of Student | 5 | 20092 | 44.02 | ** | 5 | 19871 | 33.71 | ** | 5 | 20098 | 17.08 | ** | 5 | 19877 | 12.81 | ** |
| Teacher Years Experience | 9 | 20092 | 24.28 | ** | 9 | 19871 | 2.07 | * | 9 | 20098 | 15.85 | ** | 9 | 19877 | 0.68 | ns |
| Year of Student Test | 2 | 20092 | 35.28 | ** | 2 | 19871 | 28.59 | ** | 2 | 20098 | 14.96 | ** | 2 | 19877 | 16.59 | ** |
| | | | | | | | | | | | | | | | | |
| Comparisons | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value |
| Certified vs Failed NBPTS | 1.37 | 0.22 | 6.27 | ** | 0.82 | 0.72 | 1.14 | ns | 1.09 | 0.24 | 4.50 | ** | 0.54 | 0.78 | 0.70 | ns |
| Certified vs Future NBPTS Candidate | -0.07 | 0.17 | -0.39 | ns | -0.20 | 0.69 | -0.30 | ns | -0.01 | 0.19 | -0.04 | ns | 0.16 | 0.71 | 0.23 | ns |
| Certified vs Never in NBPTS | 0.24 | 0.13 | 1.89 | ns | 0.24 | 0.46 | 0.53 | ns | 0.30 | 0.14 | 2.11 | * | 0.05 | 0.47 | 0.11 | ns |
| | | | | | | | | | | | | | | | | |
| Variance Component Estimates | Estimate | | | | Estimate | | | | Estimate | | | | Estimate | | | |
| Certified Teacher | | | | | 2.82 | | | | | | | | 2.96 | | | |
| Failed NBPTS | | | | | 2.41 | | | | | | | | 2.87 | | | |
| Future NBPTS Candidate | | | | | 4.68 | | | | | | | | 4.94 | | | |
| Never in NBPTS | | | | | 2.81 | | | | | | | | 2.86 | | | |
| Residual | 24.17 | | | | 22.01 | | | | 29.60 | | | | 27.15 | | | |

* indicates statistical significance at the 0.05 level; ** indicates statistical significance at the 0.01 level; ns means not significant.

Table A.6 Analysis Results for 4th Grade Reading

| Effect | Response Variable=Scale Score | | | | | | | | Response Variable=Simple Scale Score Gain | | | | | | | |
|-------------------------------------|-------------------------------|--------|---------|---------|--|--------|---------|---------|---|--------|---------|---------|--|--------|---------|---------|
| | Model 1 | | | | Model 2 | | | | Model 3 | | | | Model 4 | | | |
| | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | |
| Effect | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value |
| Certification Status | 3 | 37184 | 1.22 | ns | 3 | 1035 | 0.26 | ns | 3 | 37192 | 1.83 | ns | 3 | 1035 | 0.75 | ns |
| Gender of Student | 1 | 37184 | 113.32 | ** | 1 | 36149 | 116.66 | ** | 1 | 37192 | 16.09 | ** | 1 | 36157 | 16.59 | ** |
| Prev Math Score(Year) | 4 | 37184 | 876.72 | ** | 4 | 36149 | 864.47 | ** | | | | | | | | |
| Prev Read Score(Year) | 4 | 37184 | 3563.78 | ** | 4 | 36149 | 3545.80 | ** | | | | | | | | |
| Race of Student | 5 | 37184 | 108.06 | ** | 5 | 36149 | 92.75 | ** | 5 | 37192 | 11.58 | ** | 5 | 36157 | 11.31 | ** |
| Teacher Years Experience | 9 | 37184 | 14.94 | ** | 9 | 36149 | 8.11 | ** | 9 | 37192 | 8.21 | ** | 9 | 36157 | 4.58 | ** |
| Year of Student Test | 3 | 37184 | 121.24 | ** | 3 | 36149 | 113.89 | ** | 3 | 37192 | 23.28 | ** | 3 | 36157 | 18.83 | ** |
| | | | | | | | | | | | | | | | | |
| Comparisons | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value |
| Certified vs Failed NBPTS | 0.27 | 0.20 | 1.33 | ns | 0.17 | 0.29 | 0.61 | ns | 0.06 | 0.23 | 0.27 | ns | 0.03 | 0.30 | 0.11 | ns |
| Certified vs Future NBPTS Candidate | 0.17 | 0.17 | 1.04 | ns | 0.06 | 0.24 | 0.23 | ns | -0.13 | 0.19 | -0.67 | ns | -0.15 | 0.26 | -0.56 | ns |
| Certified vs Never in NBPTS | 0.02 | 0.12 | 0.14 | ns | -0.02 | 0.18 | -0.08 | ns | -0.24 | 0.13 | -1.77 | ns | -0.22 | 0.19 | -1.16 | ns |
| | | | | | | | | | | | | | | | | |
| Variance Component Estimates | Estimate | | | | Estimate | | | | Estimate | | | | Estimate | | | |
| Certified Teacher | | | | | 0.99 | | | | | | | | 0.85 | | | |
| Failed NBPTS | | | | | 0.73 | | | | | | | | 0.65 | | | |
| Future NBPTS Candidate | | | | | 0.77 | | | | | | | | 1.05 | | | |
| Never in NBPTS | | | | | 1.04 | | | | | | | | 0.91 | | | |
| Residual | 26.26 | | | | 25.31 | | | | 34.52 | | | | 33.65 | | | |

* indicates statistical significance at the 0.05 level; ** indicates statistical significance at the 0.01 level; ns means not significant.

Table A.7 Analysis Results for 5th Grade Reading

| Effect | Response Variable=Scale Score | | | | | | | | Response Variable=Simple Scale Score Gain | | | | | | | |
|-------------------------------------|-------------------------------|--------|---------|---------|--|--------|---------|---------|---|--------|---------|---------|--|--------|---------|---------|
| | Model 1 | | | | Model 2 | | | | Model 3 | | | | Model 4 | | | |
| | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | |
| Effect | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value |
| Certification Status | 3 | 36685 | 3.86 | ** | 3 | 986 | 2.12 | ns | 3 | 36693 | 0.73 | ns | 3 | 986 | 0.42 | ns |
| Gender of Student | 1 | 36685 | 120.08 | ** | 1 | 35699 | 123.67 | ** | 1 | 36693 | 2.72 | ns | 1 | 35707 | 2.59 | ns |
| Prev Math Score(Year) | 4 | 36685 | 615.95 | ** | 4 | 35699 | 618.80 | ** | | | | | | | | |
| Prev Read Score(Year) | 4 | 36685 | 4001.30 | ** | 4 | 35699 | 3947.45 | ** | | | | | | | | |
| Race of Student | 5 | 36685 | 92.32 | ** | 5 | 35699 | 77.36 | ** | 5 | 36693 | 54.59 | ** | 5 | 35707 | 38.79 | ** |
| Teacher Years Experience | 9 | 36685 | 9.17 | ** | 9 | 35699 | 4.85 | ** | 9 | 36693 | 2.91 | ** | 9 | 35707 | 2.30 | * |
| Year of Student Test | 3 | 36685 | 229.57 | ** | 3 | 35699 | 225.70 | ** | 3 | 36693 | 15.42 | ** | 3 | 35707 | 14.19 | ** |
| | | | | | | | | | | | | | | | | |
| Comparisons | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value |
| Certified vs Failed NBPTS | 0.26 | 0.20 | 1.33 | ns | 0.27 | 0.27 | 1.01 | ns | 0.29 | 0.23 | 1.26 | ns | 0.31 | 0.29 | 1.06 | ns |
| Certified vs Future NBPTS Candidate | 0.06 | 0.14 | 0.44 | ns | 0.06 | 0.20 | 0.30 | ns | 0.07 | 0.16 | 0.42 | ns | 0.03 | 0.23 | 0.14 | ns |
| Certified vs Never in NBPTS | 0.28 | 0.10 | 2.76 | ** | 0.32 | 0.16 | 2.04 | * | 0.13 | 0.12 | 1.10 | ns | 0.09 | 0.17 | 0.51 | ns |
| | | | | | | | | | | | | | | | | |
| Variance Component Estimates | Estimate | | | | Estimate | | | | Estimate | | | | Estimate | | | |
| Certified Teacher | | | | | 0.81 | | | | | | | | 0.96 | | | |
| Failed NBPTS | | | | | 0.56 | | | | | | | | 0.43 | | | |
| Future NBPTS Candidate | | | | | 0.74 | | | | | | | | 0.74 | | | |
| Never in NBPTS | | | | | 0.87 | | | | | | | | 1.02 | | | |
| Residual | 23.21 | | | | 22.41 | | | | 31.36 | | | | 30.44 | | | |

* indicates statistical significance at the 0.05 level; ** indicates statistical significance at the 0.01 level; ns means not significant.

Table A.8 Analysis Results for 6th Grade Reading

| Effect | Response Variable=Scale Score | | | | | | | | Response Variable=Simple Scale Score Gain | | | | | | | |
|-------------------------------------|-------------------------------|--------|---------|---------|--|--------|---------|---------|---|--------|---------|---------|--|--------|---------|---------|
| | Model 1 | | | | Model 2 | | | | Model 3 | | | | Model 4 | | | |
| | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | |
| Effect | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value |
| Certification Status | 3 | 23476 | 8.40 | ** | 3 | 298 | 2.90 | * | 3 | 23480 | 2.97 | * | 3 | 298 | 1.01 | ns |
| Gender of Student | 1 | 23476 | 197.92 | ** | 1 | 23178 | 196.33 | ** | 1 | 23480 | 38.16 | ** | 1 | 23182 | 42.04 | ** |
| Prev Math Score(Year) | 2 | 23476 | 1086.92 | ** | 2 | 23178 | 1032.85 | ** | | | | | | | | |
| Prev Read Score(Year) | 2 | 23476 | 4822.65 | ** | 2 | 23178 | 4608.12 | ** | | | | | | | | |
| Race of Student | 5 | 23476 | 68.95 | ** | 5 | 23178 | 52.94 | ** | 5 | 23480 | 4.89 | ** | 5 | 23182 | 3.41 | ** |
| Teacher Years Experience | 9 | 23476 | 4.82 | ** | 9 | 23178 | 1.68 | ns | 9 | 23480 | 5.09 | ** | 9 | 23182 | 3.49 | ** |
| Year of Student Test | 1 | 23476 | 1628.89 | ** | 1 | 23178 | 1425.54 | ** | 1 | 23480 | 624.11 | ** | 1 | 23182 | 443.86 | ** |
| | | | | | | | | | | | | | | | | |
| Comparisons | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value |
| Certified vs Failed NBPTS | 0.50 | 0.23 | 2.14 | * | 0.46 | 0.34 | 1.36 | ns | 0.51 | 0.26 | 1.94 | ns | 0.44 | 0.44 | 1.00 | ns |
| Certified vs Future NBPTS Candidate | 0.35 | 0.21 | 1.69 | ns | 0.12 | 0.37 | 0.33 | ns | -0.20 | 0.23 | -0.85 | ns | -0.44 | 0.41 | -1.07 | ns |
| Certified vs Never in NBPTS | 0.60 | 0.12 | 4.91 | ** | 0.58 | 0.21 | 2.73 | ** | 0.22 | 0.14 | 1.63 | ns | -0.04 | 0.25 | -0.16 | ns |
| | | | | | | | | | | | | | | | | |
| Variance Component Estimates | Estimate | | | | Estimate | | | | Estimate | | | | Estimate | | | |
| Certified Teacher | | | | | 0.47 | | | | | | | | 0.66 | | | |
| Failed NBPTS | | | | | 0.25 | | | | | | | | 0.67 | | | |
| Future NBPTS Candidate | | | | | 0.85 | | | | | | | | 0.99 | | | |
| Never in NBPTS | | | | | 0.79 | | | | | | | | 1.48 | | | |
| Residual | 26.56 | | | | 25.96 | | | | 33.66 | | | | 32.64 | | | |

* indicates statistical significance at the 0.05 level; ** indicates statistical significance at the 0.01 level; ns means not significant.

Table A.9 Analysis Results for 7th Grade Reading

| Effect | Response Variable=Scale Score | | | | | | | | Response Variable=Simple Scale Score Gain | | | | | | | |
|-------------------------------------|-------------------------------|--------|---------|---------|--|--------|---------|---------|---|--------|---------|---------|--|--------|---------|---------|
| | Model 1 | | | | Model 2 | | | | Model 3 | | | | Model 4 | | | |
| | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | |
| Effect | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value |
| Certification Status | 3 | 16740 | 2.26 | ns | 3 | 213 | 2.25 | ns | 3 | 16744 | 4.45 | ** | 3 | 213 | 2.62 | ns |
| Gender of Student | 1 | 16740 | 96.23 | ** | 1 | 16527 | 90.77 | ** | 1 | 16744 | 0.15 | ns | 1 | 16531 | 0.03 | ns |
| Prev Math Score(Year) | 2 | 16740 | 626.36 | ** | 2 | 16527 | 605.73 | ** | | | | | | | | |
| Prev Read Score(Year) | 2 | 16740 | 3553.00 | ** | 2 | 16527 | 3397.04 | ** | | | | | | | | |
| Race of Student | 5 | 16740 | 18.77 | ** | 5 | 16527 | 16.05 | ** | 5 | 16744 | 138.81 | ** | 5 | 16531 | 77.76 | ** |
| Teacher Years Experience | 9 | 16740 | 12.05 | ** | 9 | 16527 | 3.79 | ** | 9 | 16744 | 1.82 | ns | 9 | 16531 | 0.47 | ns |
| Year of Student Test | 1 | 16740 | 180.94 | ** | 1 | 16527 | 174.37 | ** | 1 | 16744 | 8.47 | ** | 1 | 16531 | 6.23 | * |
| | | | | | | | | | | | | | | | | |
| Comparisons | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value |
| Certified vs Failed NBPTS | -0.42 | 0.21 | -1.99 | * | -0.49 | 0.31 | -1.59 | ns | -0.28 | 0.27 | -1.04 | ns | -0.49 | 0.61 | -0.82 | ns |
| Certified vs Future NBPTS Candidate | 0.21 | 0.22 | 0.96 | ns | 0.15 | 0.46 | 0.32 | ns | 0.22 | 0.28 | 0.78 | ns | 0.10 | 0.55 | 0.17 | ns |
| Certified vs Never in NBPTS | -0.11 | 0.13 | -0.89 | ns | 0.05 | 0.28 | 0.19 | ns | -0.46 | 0.17 | -2.80 | ** | -0.75 | 0.29 | -2.58 | * |
| | | | | | | | | | | | | | | | | |
| Variance Component Estimates | Estimate | | | | Estimate | | | | Estimate | | | | Estimate | | | |
| Certified Teacher | | | | | 0.85 | | | | | | | | 0.47 | | | |
| Failed NBPTS | | | | | 0.00 | | | | | | | | 2.05 | | | |
| Future NBPTS Candidate | | | | | 0.76 | | | | | | | | 1.31 | | | |
| Never in NBPTS | | | | | 1.03 | | | | | | | | 2.40 | | | |
| Residual | 23.22 | | | | 22.51 | | | | 39.46 | | | | 37.86 | | | |

* indicates statistical significance at the 0.05 level; ** indicates statistical significance at the 0.01 level; *ns* means not significant.

Table A.10 Analysis Results for 8th Grade Reading

| Effect | Response Variable=Scale Score | | | | | | | | Response Variable=Simple Scale Score Gain | | | | | | | |
|-------------------------------------|-------------------------------|--------|---------|---------|--|--------|---------|---------|---|--------|---------|---------|--|--------|---------|---------|
| | Model 1 | | | | Model 2 | | | | Model 3 | | | | Model 4 | | | |
| | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | | Fixed Effects Only | | | | Fixed Effects and Random Teacher(Certification Status) | | | |
| Effect | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value | Num DF | Den DF | F-Value | p-Value |
| Certification Status | 3 | 19812 | 1.24 | ns | 3 | 218 | 2.42 | ns | 3 | 19818 | 12.03 | ** | 3 | 218 | 2.71 | * |
| Gender of Student | 1 | 19812 | 105.34 | ** | 1 | 19594 | 100.58 | ** | 1 | 19818 | 0.24 | ns | 1 | 19600 | 0.47 | ns |
| Prev Math Score(Year) | 3 | 19812 | 696.71 | ** | 3 | 19594 | 666.41 | ** | | | | | | | | |
| Prev Read Score(Year) | 3 | 19812 | 2626.00 | ** | 3 | 19594 | 2471.82 | ** | | | | | | | | |
| Race of Student | 5 | 19812 | 48.19 | ** | 5 | 19594 | 39.95 | ** | 5 | 19818 | 37.76 | ** | 5 | 19600 | 20.90 | ** |
| Teacher Years Experience | 9 | 19812 | 6.13 | ** | 9 | 19594 | 3.14 | ** | 9 | 19818 | 3.69 | ** | 9 | 19600 | 2.56 | ** |
| Year of Student Test | 2 | 19812 | 113.84 | ** | 2 | 19594 | 97.42 | ** | 2 | 19818 | 28.20 | ** | 2 | 19600 | 24.73 | ** |
| | | | | | | | | | | | | | | | | |
| Comparisons | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value | Est. | SE | t-Value | p-value |
| Certified vs Failed NBPTS | 0.40 | 0.27 | 1.50 | ns | 0.36 | 0.28 | 1.28 | ns | 1.39 | 0.33 | 4.20 | ** | 1.42 | 0.86 | 1.64 | ns |
| Certified vs Future NBPTS Candidate | 0.28 | 0.19 | 1.47 | ns | 0.37 | 0.30 | 1.25 | ns | 0.13 | 0.24 | 0.57 | ns | 0.34 | 0.42 | 0.81 | ns |
| Certified vs Never in NBPTS | 0.11 | 0.13 | 0.80 | ns | 0.49 | 0.18 | 2.68 | ** | -0.31 | 0.16 | -1.91 | ns | -0.24 | 0.36 | -0.66 | ns |
| | | | | | | | | | | | | | | | | |
| Variance Component Estimates | Estimate | | | | Estimate | | | | Estimate | | | | Estimate | | | |
| Certified Teacher | | | | | 0.08 | | | | | | | | 1.31 | | | |
| Failed NBPTS | | | | | 0.00 | | | | | | | | 2.11 | | | |
| Future NBPTS Candidate | | | | | 0.49 | | | | | | | | 0.32 | | | |
| Never in NBPTS | | | | | 1.00 | | | | | | | | 1.12 | | | |
| Residual | 23.29 | | | | 22.66 | | | | 35.86 | | | | 35.03 | | | |

* indicates statistical significance at the 0.05 level; ** indicates statistical significance at the 0.01 level; *ns* means not significant.