# STUDENT MATHEMATICS PERFORMANCE IN THE FIRST TWO YEARS OF *TEACH TO ONE: MATH*

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# Contents

## Executive Summary

This report examined test-score outcomes associated with the first two years of implementation of *Teach to One: Math (TTO)*, an innovative blended-learning approach to middle school mathematics instruction developed by New Classrooms Innovation Partners. *TTO* was implemented in seven schools in grades 6-8 during the 2012-2013 academic year, and fifteen schools in grades 5-8 during the 2013-2014 academic year. All schools were located in large, urbanized areas including New York City, Chicago, Washington, D.C., Charlotte, N.C., and northern New Jersey.

The methods and available data were not able to produce causal evidence of the impact of *TTO* on student outcomes. Instead, mathematics skills development among *TTO* students was compared to that of other students nationally using student-level test scores on the Measures of Academic Progress (MAP) assessment, an established and widely used test developed by the Northwest Evaluation Association (NWEA).

Key findings from these first two years of *TTO* implementation:

- *TTO* students in both implementation years had initial mathematics skills that were well below national averages.
- However, during the 2012-2013 school year *TTO* students gained mathematics skills at a rate that was roughly 15% higher than the national average (effect size=0.12 *SD*). In the second year of implementation—the 2013-2014 academic year—gains among *TTO* students were almost 47% above national norms (effect size=0.35 SD), a sizable improvement over the first implementation year.
- Across both academic years, students who started with the weakest mathematics skills made the largest gains. During the first year of implementation, gains among high-achieving students were below national averages, but were comparable to national gain norms during the second year of implementation.
- During year one, only two of seven schools exhibited gains that were significantly above national norms. In year two, gains in 11 of 15 schools were significantly above average.
- Black students' gains were below the overall national average during the first year of *TTO*, but were roughly 36% above average during the second year of implementation.

# STUDENT MATHEMATICS PERFORMANCE IN THE FIRST TWO YEARS

## OF *TEACH TO ONE: MATH*

## Introduction

Teach to One (*TTO*), developed by New Classrooms Innovation Partners, represents a fundamentally different approach to teaching mathematics in grades 5-8. The model seeks to leverage personalization and multiple instructional approaches to improve student mathematics performance.[1] Implementation of the *TTO* program began in the 2012-13 school year with roughly 3,500 students and eight schools in Chicago, New York City, and Washington, D.C. During the 2013-2014 school year, over 6,000 students in 15 schools experienced *TTO*, with schools added in Charlotte, North Carolina and in several urban communities in northern New Jersey.

Teach to One students are assessed daily to determine current skill levels, and an algorithm employs these test results to target content delivery for the following day. In addition to creating daily learning plans for each student, this adaptive, self-improving algorithm also generates a unique daily instruction schedule for each teacher. An additional key aspect of the model is that *TTO* integrates multiple technology-enabled and live instruction modalities simultaneously into each classroom. At any moment in a given classroom, students may be working in one of eight learning modalities, including teacher-led instruction; small-group collaboration with three to six students; peer-to-peer collaboration with two to three students; virtual instruction via digital lessons; virtual reinforcement of specific concepts; virtual 1:1 live tutoring; independent practice; and multi-day sessions involving real-world tasks related to mathematics.

In using this approach of daily assessment combined with targeted learning stations, *TTO* seeks to offer instruction that is continually responsive to the student's current demonstrated abilities. According to *TTO*, the process also provides teachers with real-time information about student performance and frees their time to support individual and collaborative groups of students. New Classrooms personnel relied upon the Common Core State Standards in the construction of the *TTO* curriculum. Teacher and student web-based portals also provide complete, real-time

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[1] see www.newclassrooms.org

information on student progress and enable students and teachers to navigate their schedules and lessons and review performance history. Students are able to log in to the portal 24 hours a day to review lessons, prepare for exams, share their progress with their parents, and access a variety of resources to supplement in-class learning.

**Evaluating Teach to One Student Outcomes: Data and Methods**

The set of analyses contained in this report explore mathematics achievement among *TTO* students. The analyses do not seek to establish a causal link between *TTO* and student learning in mathematics, meaning that potential differences in skills development rates between *TTO* and other students nationally cannot be attributed solely to *TTO*. Instead, this report compares academic performance among *TTO* students to national norms using a large-scale, longitudinal mathematics assessment that provides estimates of student learning during the academic year.

This report uses data from the first two years of *TTO* implementation. For year one—the 2012-2013 academic year—the data include information on 2,264 *TTO* students who attended one of seven[2] participating schools in sixth (*n=832*), seventh (*n=819*), or eighth grade (*n=613*).[3] The year two (2013-2014) data include 4,117 students across 15 schools who were in fifth (*n=220*), sixth (*n=1,458*), seventh (*n=1,320*) or eighth grade (*n=1,119*). As indicated in Table 1, the demographic backgrounds of these students differ considerably from those of their public school peers nationally. The *TTO* students were far more likely to be black, Hispanic, or Asian, and far less likely to be white. Similarly, nearly all *TTO* students received free/reduced-price lunch, compared to fewer than half of students nationwide. Year-one *TTO* students were also over twice as likely to have English as their second language. Moreover, the schools attended by these students were generally located in large, urban school districts—Chicago, New York City, Washington, D.C., Charlotte, N.C., and several urban areas of northern New Jersey—that face unique challenges in terms of fiscal constraints and the populations they serve.

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[2] One school was excluded from this study because the impact of Hurricane Sandy interrupted its implementation of *TTO* for an extended period of time.
[3] Analyses for 2012-2013 only include *TTO* students who attended at least 70% of *TTO* classes during the 2012-13 academic year, completed both the fall and spring MAP mathematics assessments, and spent at least six minutes taking the "short" MAP assessment. Analyses were run without these exclusions, and the differences were negligible. For 2013-2014, these analyses included students who attended at least 70% of *TTO* classes, and who had both a MAP pre- and a post-test (discussed in greater detail below).

. Characteristics of *Teach to One* Students and Public School Students Nationally

| Demographic Characteristic | Teach to One Students 2012-2013 ($n$=2,264) | Teach to One Students 2013-2014 (n=4,117) | Nationwide |
|---|---|---|---|
| Race/Ethnicity | | | |
| % American Indian/Alaskan Native | 0.5 | 0.1 | 1.2 |
| % Asian/Pacific Islander | 15.2 | 10.3 | 5.2 |
| % Black | 38.6 | 32.5 | 15.8 |
| % Hispanic | 32.8 | 43.0 | 23.9 |
| % White | 12.9 | 13.2 | 51.4 |
| % Multiracial | 0.1 | 0.9 | 2.5 |
| | | | |
| % Free/Reduced-Price Lunch | 91.3 | 94.8 | 48.1 |
| % English is Second Language | 22.7 | 10.3 | 9.8 |
| % Special Education | 13.8 | 8.0 | 12.9 |

Source: *Teach to One* data provided by New Classrooms Inc.; national data retrieved from National Center for Education Statistics (available at: http://nces.ed.gov/programs/digest/2012menu_tables.asp)

To explore mathematics skills development among these *TTO* students and to compare that development to national norms, these analyses used student-level data on the Measures of Academic Progress (MAP) mathematics assessment, created and managed by the Northwest Evaluation Association (NWEA). The MAP assessments are untimed, computer adaptive tests that draw on thousands of possible questions, depending on each student's ability level.[4] Year-one *TTO* students completed the MAP assessment in Fall 2012 and again in Spring 2013. Variability across schools in when the MAP assessments were administered during year two required the use of three different growth measurement periods. For three schools, growth is measured from Spring, 2013 to Spring, 2014; for 10 schools growth was measured from Fall, 2013 to Spring, 2014 (the same time frame as the year-one schools); and for two schools growth was measured from Winter, 2014 to Spring, 2014.[5]

NWEA has released national MAP math assessment norms for all grades for both achievement and achievement gains. These analyses compared mathematics performance among *TTO* students to these national norms. Due to (relatively weak) correlations between initial status and subsequent mathematic gains—positive in fifth, sixth and seventh grade, but negative in eighth

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[4] For more information on the MAP assessments, see www.nwea.org
[5] Student-level achievement gains were standardized (z-scored) to permit comparisons across schools participating in each of the three testing periods. See footnote 6 below.

grade—NWEA calculates growth norms based on initial achievement strata.[6] Moreover, because schools across the country administer the MAP tests at different times during the academic year, norms are also published based on which months students completed the pre- and post-tests (more time between tests is associated with larger achievement gains). These considerations permit comparisons of mathematics skills growth among *TTO* students to a national sample of students who had similar initial mathematics skills and similar numbers of instructional days during each growth measurement period. When appropriate, results are presented in effect size differences between *TTO* student test scores (or test-score gains) and national norms.[7]

Unfortunately, NWEA has not released national MAP norms broken down by student sub-groups. This represents an important limitation, given that *TTO* students are far from nationally representative (see Table 1 above). The differences between *TTO* students and the typical public school student and the fact that the MAP norms are based on student samples that are more nationally representative, suggests that the results presented below are potentially conservative estimates of the performance differences between *Teach to One* students and *similar* students nationally.

**Findings – Year One**

As indicated in Figure 1, on average across all grades, *TTO* students started the 2012-13 academic year with mathematics skills that lagged behind national norms. In sixth grade, *TTO* students began the academic year at a statistically significant disadvantage of 4.5 points compared to their peers nationally (ES = -0.29; *p*<.001).[8] A somewhat smaller (but still statistically significant) initial gap of 2.8 points existed among seventh graders (ES = -17; *p*<.001), and a much larger deficit of 6.8 points in eighth grade (ES = 0.40; *p*<.001).[9] These initial differences prior to the start of *TTO* were quite understandable given the fact that, as noted above, *TTO* students were more likely to come from disadvantaged backgrounds compared to the

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[6] see: Northwest Evaluation Association. (2011). RIT scale norms: For use with Measures of Academic Progress (MAP) and MAP for Primary Grades. Portland, OR: Author.

[7] To calculate a standardized difference score, the national norm gain for students who started within particular initial achievement strata was subtracted from each student's actual gain. This difference score was then divided by the national average standard deviation of gain for that grade and time period.

[8] An effect size (ES) is the mean difference between two groups divided by the standard deviation of the outcome being explored. A general rule is to interpret ESs smaller than 0.1 SD as trivially small; 0.1-0.3 SDs as small; 0.3-0.5 SDs as moderately large; and ESs larger than 0.5 as large.

[9] All indications of statistical significance were obtained from one-sample t-tests.

students on whose skills these national norms were based. The question, however, and the primary focus in this study, was how much *TTO* students learned while in the program. *TTO* students began the year with weaker math skills. But was their subsequent academic *growth* generally below, comparable to, or above the gains made by students nationally on the same assessment?



Figure 1. Teach to One Initial (Fall) MAP Test Scores Compared to National Norms (2012-2013)

***p<.001; significance tests compare to same-grade national norm. Includes students who spent at least 70% of the academic year in a *Teach to One* classroom, and who spent at least six minutes on both the fall and spring MAP.

As indicated in Figure 2, *TTO* students gained somewhat more than their same-grade peers nationally who began the school year with similar mathematics skills, and who took the MAP assessments during the same timeframe. These findings can be interpreted in terms of one-year expected growth. If one understands the national norms to roughly represent one year of academic growth (fall to spring gains), *TTO* students achieved 1.14 years of growth in sixth and seventh grade, or 14% more than the typical student nationally, while eighth graders gained 1.17 years of growth, or 17% more than the national average. Across all grades, *TTO* student gains

were roughly 1.15 times greater than national norms, or 15% greater.[10] Expressed in terms of standard deviation units, sixth graders gained 0.14 standard deviations more ($p<.05$), while seventh and eighth graders gained 0.10 and 0.12 standard deviations more, respectively ($p<.10$).

It should be stressed again, however, that *TTO* students are by no means nationally representative. Considering the relatively disadvantaged backgrounds of *TTO* students, the fact that their average MAP test score gains in mathematics were above the national norms is noteworthy. It is equally important to bear in mind that these analyses are unable to attribute the greater gains among *TTO* students to *TTO* itself. While these gains may very well be attributable to *TTO*, they may also flow from other unmeasured characteristics of students, their teachers and principals, or other school and community characteristics.



Figure 2. Teach to One MAP Gains by Grade Compared to National Norms (2012-2013)

~$p<.10$; *$p<.05$; significance tests compare to same-grade, same initial achievement strata national norm.

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[10] This conclusion that *TTO* students gained math skills at a rate 1.15 times greater than the national average differs slightly from the rate of 1.19 times the national average reported in an earlier evaluation of *TTO* by the same author (and colleagues). The result here more accurately reflects the fact that *TTO* students completed the MAP assessments roughly one month later than the national average, and thus had somewhat more instructional time compared to their peers nationwide.

Disaggregating the results indicates that these gains differed by students' initial mathematics abilities. Figure 3 displays average annual gains organized by students' initial (fall) mathematics ability. The national grade-specific distribution of fall achievement was divided into thirds based on percentile ranking. Students falling into the bottom third of the test score distribution are labeled low achieving, those in the middle third categorized as average achieving, and those in the top third of the distribution are considered to be high achieving. *TTO* students were then categorized into one of these three groups based on their own fall achievement. The relatively low-levels of initial mathematics achievement among *TTO* students are quite apparent, with well over half of all *TTO* students categorized as low-achieving, and under 14% categorized as high-achieving. As indicated in Figure 3, low-achieving *TTO* students gained 37% more than other initially low-achieving students nationally (ES = 0.29; *p*<.001), while average-achieving *TTO* students gained skills at a rate that was statistically comparable to the national norm (*p*>.05). The relatively smaller number of high-achieving *TTO* students, however, gained skills at a rate that only 74% of the national average (ES = -0.22; *p*<.05).



Figure 3. Teach to One MAP Gains by Student Initial Achievement Compared to National Norms (2012-2013)

*p<.05; ***p<.001; significance tests compare to same-grade, same initial achievement strata national norm.

Figure 4 disaggregates mathematics gains by student demographic background.[11] As noted above, and as indicated by the first bar on the left, on average across schools and grades, *TTO* students gained skills at a rate 1.15 times (or 15% above) the national average ($p<.001$). Somewhat surprisingly, *TTO* English-language learners and free/reduced-price lunch eligible students all made gains that were above the national norms (20 and 17% greater, respectively), as did white, Asian, and Hispanic students, on average. During this first year of implementation, black students were the only student subgroup to experience mathematics learning rates that were below national norms. Special education *TTO* students gained skills that were comparable to the national norm (of all students, not only special education students).



Figure 4. Teach to One MAP Gains by Demographic Subgroup Compared to National Norms (2012-2013)

~$p<.10$; *$p<.05$; ***$p<.001$

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[11] As a reminder, NWEA does not publish norms by student subgroups. As such, Figure 4 simply compares mean gains among *TTO* student subgroups to the grade-specific and testing timeframe-relevant national norms *for all students*.

It is important to also note that student gains varied across *TTO* schools. Describing only average gains across schools masks these differences. Each of the seven 2012-2013 *TTO* schools are provided pseudonyms in Figure 5. On average across grades, gains in two schools were above national norms. Indeed, students in "School A" gained skills at almost double the national rate. Gains in four schools were statistically comparable to national norms ($p>.05$), although three of these four school means were above the national norms.[12] Students in "School G" gained skills at less than half the national rate ($p<.001$). Interpretations of the below-average gain observed in one school should again take into account that *TTO* students and schools are not representative, unlike the students and schools on which these national norms are based. "School A" was removed in a separate analysis to determine whether this single school was driving the results presented above. Doing so did render all grade-specific differences non-significant (i.e., statistically, *TTO* schools performed neither better nor worse compared to national averages). The report now turns to the second-year evaluation results.



Figure 5. Teach to One MAP Gains by School Compared to National Norms (2012-2013)

*p<.05; ***p<.001; significance tests compare to same-grade national norm.

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[12] The lack of statistically significant differences here is driven in part by the relatively small sample sizes associated with these school-specific analyses.

**Findings – Year Two**

As they did in Fall 2012, on average across all grades, *TTO* students started the 2013-14 academic year with mathematics skills that lagged behind national norms (see Figure 6).[13] In fifth and sixth grades, *TTO* students began the academic year at a statistically significant disadvantage of 0.50 standard deviations compared to their peers nationally (*p*<.001). A slightly smaller (but still statistically significant) initial gap of 0.43 standard deviations was found among seventh graders (*p*<.001), and a much larger deficit of 0.60 standard deviations in eighth grade (*p*<.001). As with the first year of *TTO* implementation, however, the more important question is how academic *growth* among *TTO* students compared to national norms.



Figure 6. Teach to One Initial MAP Test Scores Compared to National Norms (2013-2014)

***p<.001; significance tests compare to same-grade, same testing time-period national norm.

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[13] In contrast to Figure 1, which displayed TTO students' skills in raw MAP score points, initial status here is indicated in effect sizes. This is because in contrast to the 2012-2013 academic year, when all TTO students completed the map assessments during essentially the same time period, and thus students in each grade could be compared to the identical national norm, during the 2013-2014 academic year students' "initial status" was compared to the national norms associated with three different initial status periods: Spring 2013, Fall 2013, and early Winter 2014.

As indicated in Figure 7, on average, *TTO* students gained more mathematics skills compared to their same-grade peers nationally who began the school year with similar mathematics skills, and who took the MAP assessments during the same time-frames. [14] Fifth graders' gains were 28% above the national average (ES = 0.17; $p<.10$),[15] while sixth, seventh and eighth graders gained skills at rates there were 28, 73, 43% above their national norms, respectively (ES = 0.24, 0.53, 0.31; $p<.001$). Averaged across all grades, student gains were 47% above national norms (ES = 0.35; $p<.001$). It is important to note that these gains made during the second year of *TTO* implementation (2013-2014) were considerably larger than those made during year one (2012-2013). On average across grades in year one, gains among *TTO* students were 15% larger than the national average. With the second year of implementation, *TTO* students' gains were roughly 47% greater than national norms.



Figure 7. Teach to One MAP Gains by Grade Compared to National Norms (2013-2014)

$\sim p<.10$; ***$p<.001$; significance tests compare to same-grade, same initial achievement strata national norm..

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[14] For students whose gains were measured from spring to spring or from fall to spring, one can interpret this as one year of expected gains.
[15] The fact that this difference is only marginally significant ($p<.10$) is related in part to the relatively small number of *TTO* fifth graders (n=220).

These year-two results, however, again differ depending on students' initial mathematics abilities. Figure 8 displays average annual gains organized by students' mathematics ability at the start of their particular testing time period (Spring 2013, Fall 2013, or Winter 2014). The national grade-specific distribution of initial achievement was divided into thirds based on percentile ranking. The relatively low levels of initial mathematics achievement among *TTO* students are again quite apparent, with well over half of all TTO students categorized as low achieving, and under 18% categorized as high achieving. As indicated in Figure 8, low-achieving *TTO* students gained skills at a rate that was 81% above the national average, (ES = 0.61; *p*<.001), while average-achieving *TTO* students' gains were 21% above the national norm (ES = 0.17; *p*<.001). The relatively smaller number of high-achieving TTO students, however, gained skills at a rate that was statistically comparable to the national average (*p*>.05). This stands in stark contrast to the year-one results, in which gains among high-achieving students were significantly below national averages.



Figure 8. Teach to One MAP Gains by Student Initial Achievement Compared to National Norms (2013-2014)

***p*<.001; significance tests compare to same-grade, same initial achievement strata national norm.

Figure 9 disaggregates mathematics gains by student demographic subgroups. These results are far stronger than the similar analyses using year-one data (see Figure 4 above). All student subgroups, including those traditionally associated with weaker academic performance, gained skills at rates above national averages ($p<.001$). Notable is the fact that black *TTO* students' gains were 65% above national norms during the 2013-2014 academic year, but were below average during the 2012-2013 school year.



Figure 9. Demographic Subgroup Performance: Average Teach to One Gains Relative to National Norms (2013-2014)

As they did during year-one implementation, student gains varied considerably across *TTO* schools, although school-level average gains were far stronger during the second year of implementation.[16] On average across grades, gains in eleven of the fifteen *TTO* schools were significantly above national norms during the 2013-2014 academic year (see Figure 10). Gains in two schools were statistically comparable to national norms ($p>.05$), while gains in two other schools were significantly below national norms. These year-two school-level results are

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[16] School pseudonyms are not consistent across Figures 5 and 10 (e.g., "School A" is not the same in both figures).

noticeably improved compared to year one, when only two of the seven *TTO* schools exhibited gains that were significantly above national norms (see Figure 5 above).



Figure 10. Average Annual MAP Gains by School (2013-2014)

**\*\*p<.01; \*\*\*p<.001; significance tests compare to same-grade, same initial achievement strata national norm.*

**Conclusions**

These analyses provide student test-score results from the first two years of implementation of *Teach to One: Math*, which was implemented in seven schools in grades 6-8 during the 2012-2013 academic year, and fifteen schools in grades 5-8 during the 2013-2014 academic year. *TTO* served students who were academically and demographically less advantaged compared to their peers nationally. These students, who typically started each academic year with mathematics skills that were far below national averages, were virtually all eligible for free/reduced-price lunches, attended schools in high-poverty, high-needs communities, and were predominantly black and Hispanic.

Despite these considerable disadvantages, *TTO* students gained mathematics skills at rates that surpassed those of other students nationally. In the first year of implementation, across all grades and schools, average gains among *TTO* students were 15% above national averages. During the second year of implementation, average gains were roughly 47% above national averages—a marked improvement. Gains were also stronger among student subgroups during the second year of implementation, when all *TTO* student subgroups scored above the national norm.

During year one, student gains were uneven across schools, with only two of seven schools making gains that were significantly above national norms. Gains across schools were far stronger in the second year of implementation, when 11 of 15 schools exhibited average gains that were significantly above national norms. Interestingly, given the generally low levels of initial achievement among *TTO* students, across both implementation years, gains were strongest among the lowest-achieving students.

It is important to stress again that these findings cannot be attributed to *TTO* without the use of experimental or quasi-experimental designs. In other words, we cannot state definitively that *TTO* caused the above-average achievement gains noted above. The available data did not include information on the characteristics and backgrounds of teachers or administrators in these schools, and we therefore know little about how they compare to those in similar schools nationally. Adding to the ambiguity is the fact that the norms against which *TTO* students were compared were based on student samples that were on average academically and demographically far more advantaged. However, given their academic and demographic profiles, it is encouraging that *TTO* students exhibited skills gains that were above these national averages. In light of these multiple uncertainties, which may have biased these findings in unknown directions, future research should employ data and analytic methods that afford causal estimates of the effects of *TTO* on student learning.

Despite these caveats, these early results are quite promising. This is particularly so given the improvement in gains during the second year of implementation, with a larger and equally disadvantaged group of students and schools.