

# EVALUATING THE EFFECTIVENESS OF TURNAROUND EFFORTS IN LOW-PERFORMING HIGH SCHOOLS

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**POLICY QUESTION: Has the Department of Public Instruction's turnaround program been effective in improving struggling high schools?**

## EXECUTIVE SUMMARY

This paper will examine the effectiveness of state turnaround efforts in the low-performing high schools initially identified for assistance from the Department of Public Instruction. To do so, we examine trends in student performance composites<sup>1</sup>, graduation and attendance rates, and the number of short-term suspensions at each high school from the 2005-2006 school year through the 2008-2009 school year. These values, taken together, provide a more complete picture of student achievement than a single measurement of any kind.

Our research shows that school turnaround support is associated with increases in performance composites and the number of short-term suspensions, but is not associated with changes in school attendance or graduation rates. These results hold promise as the Department of Public Instruction continually self-monitors and improves the support that it provides to struggling schools. Future research should incorporate newly available data to examine whether the trends identified here continue in the future. With student achievement beginning to rise, the State is making progress on its commitment to provide a sound basic education for all students.

## POLICY BACKGROUND<sup>2</sup>

North Carolina has been actively involved in the improvement of low-performing schools for more than a decade. Beginning in the 1990s, State Assistance Teams helped struggling schools design plans for reform, then trained teachers and administrators to implement the changes.

### **LEANDRO V. NORTH CAROLINA**

The 1997 *Leandro v. North Carolina* case was a major turning point in state involvement in low-performing schools. In this case, the North Carolina Supreme Court found that low-income students throughout the state were not receiving the "sound basic education" to which they were entitled under the state constitution. After Superior Court Judge Howard Manning received the case, he ruled that the state was not doing enough to improve the quality of education in low-performing schools (Manning and Wilson, 2002).

### **TURNAROUND SCHOOLS**

Over the next two years, Judge Manning, former Governor Michael Easley, and the Department of Public Instruction identified sixty-five high schools to receive intensive assistance from the state. They selected the schools on the basis of low End-of-Course exam performance composites. Departing from the existing State Assistance Team structure, the Department organized turnaround teams to provide the support to schools. Thirty-five schools entered the turnaround program during the 2006-2007 school year, and thirty schools entered in the 2007-2008 school year.

<sup>1</sup> A school's performance composite measures the percentage of students who pass their End-of-Course Exams with a level 3 score or higher. End-of-Course Exams are scored on a scale of 1 through 4, with level 3 and above considered proficient.

<sup>2</sup> For more detailed background, including a thorough discussion of *Leandro v. North Carolina*, please see Appendix I.





## DISTRICT AND SCHOOL TRANSFORMATION DIVISION

Two years after beginning turnaround support, the Department of Public Instruction re-envisioned its High School Turnaround Office as a more expansive set of supports to assist entire districts in improving student performance. The Department created a new division, the District and School Transformation division, and partnered with five local education agencies (Bertie County, Columbus County, Hertford County, Lexington City, and Richmond County) to improve education in those areas. The Department and the local education agencies agreed to reform not only the central office administration in each locality, but also to strengthen each school within those local education agencies (North Carolina Department of Public Instruction, 2010a).

## HALIFAX COUNTY

It is important to note that the Department of Public Instruction's school and district transformation team is involved in one school district because of a court order. In 2009, following up on his vow to re-structure failing schools, Judge Manning ordered a hearing to determine who should run Halifax County Schools. He declared that the district was depriving students of their right to equal access to a sound basic education. He characterized the schools' poor record as "academic genocide." As a result, he ordered increased state oversight of Halifax County Schools. He directed the state Department of Public Instruction to come up with a plan to be approved by the Halifax Board of Education, the State Board of Education, and Judge Manning himself. The Department of Public Instruction developed a three-year plan for state intervention, to which all parties agreed through a consent order (Waggoner, 2009).

## DESCRIPTION OF TURNAROUND SCHOOLS

As Table 1 indicates, schools entering turnaround faced significantly more challenges than typical high schools in the state. This fact is to be expected, given that the schools had demonstrated low student achievement for multiple years before being selected for turnaround support. Approximately half of the schools in the 2007 cohort had performance composites below 55 percent in 2006, and during the previous four years. The remainder of the schools in the cohort had performance composites of 60 percent and below for 2006, and the previous two years. All schools in the 2008 cohort met these same criteria. (North Carolina Department of Public Instruction, 2010c).

On average, turnaround schools had significantly lower performance composites and graduation rates, and slightly lower percentages of teachers with full licensure than typical high schools. Suspension rates, the percentages of students eligible for free or reduced-price lunch, and the percentages of non-white students were all significantly higher in turnaround schools. Within the turnaround schools, the 2007 cohort had a lower performance composite than the 2008 cohort. In addition, student body characteristics differed between the two cohorts, with 2008 schools reporting a larger percentage of free or reduced-price lunch eligible and nonwhite students.

**TABLE 1: Description of school characteristics (2005-2006 school year data)**

School Characteristics and Outcomes	All High Schools	2007 Turnaround Schools	2008 Turnaround Schools
Performance composite	67.5	45.8	54.3
Graduation rate	70.0	64.5	58.8
Attendance rate	93.9	91.9	92.5
Number of short-term suspensions per 100 students	36.1	47.9	44.9
Enrollment	1,041	1,003	897
Percentage of fully licensed teachers	84.1	73.5	80.1
Percentage of students eligible for free or reduced price lunch	38.7	61.5	54.3
Percentage of student body that is non-white	40.8	82.0	61.2

## DESCRIPTION OF SCHOOL TURNAROUND SERVICES<sup>3</sup>

Each high school in turnaround must complete a Framework for Action document that details its plans for reform, including support for struggling students, increased parental and community involvement, and effective use of student data. Schools must also select a reform model to restructure the school; options included the North Carolina New Schools Project, two national non-profit organizations, and a self-reform model (Trenholme, 2007).

Schools in turnaround have access to a wide range of resources, including professional development for teachers and support for principals. Department of Public Instruction staff members travel to schools to conduct a comprehensive needs assessment, which identifies strengths and areas for improvement. Leadership facilitators provide training to principals, while instructional facilitators work with classroom teachers to improve curriculum and student achievement (North Carolina Department of Public Instruction, 2010b). The intensive nature of the professional development provided to teachers and administrators is intended to train staff members to realize significant gains in student achievement.

## DATA<sup>4</sup>

To evaluate the effectiveness of the turnaround program, we used data from a variety of sources. We assembled data on the following variables from the North Carolina School Report Card database, the Department of Public Instruction's website, and the division of District and School Transformation.

### Outcome Measures:

- Percent composite (percentage of students who pass End-of-Course exams with level 3 score or higher)
- Attendance rate
- Graduation rate
- Number of short-term suspensions (per 100 students)

### School Characteristics:

- Whether a high school received turnaround support
- School enrollment
- Percentage of students who are eligible for free or reduced-price lunch
- Whether a high school's local education agency received district transformation support
- Percentage of teachers who are fully licensed
- Percentage of the student body that is non-white

To facilitate comparisons between turnaround and non-turnaround schools, we assembled data on all traditional public high schools in North Carolina. Our analysis excludes charter, alternative, and special education schools, as these schools do not participate in the turnaround program. To compare school performance before and after entering school turnaround, we collected data on the 2005-2006 through 2008-2009 school years.

In recent years, many larger high schools have broken into several smaller schools, each with a different academic focus. Although these smaller schools report data separately, they are still housed in the same physical location. For the purposes of our report, we recombined the data for such schools. This choice reflects recent legislative action that eliminates separate school codes for smaller "career academies" that are located within larger high schools (House Bill 1700 and Senate Bill 1202).

<sup>3</sup> For more detailed information on school turnaround services, please see Appendix II. <sup>4</sup> For more detailed information on our data sources, please see Appendix III.

## METHODOLOGY<sup>5</sup>

We used two statistical approaches to evaluate the effectiveness of turnaround: an ordinary least squares regression model and a panel data regression model with fixed effects.

### MODEL 1: ORDINARY LEAST SQUARES REGRESSION

Model 1 uses ordinary least squares (OLS) regression to analyze how performance composites and graduation, attendance, and suspension rates changed between the 2005-2006 and 2008-2009 school years. The model incorporates control variables to account for the effects of a variety of school and student body characteristics. While the model's output is easy to interpret, it cannot control for many important factors that influence school performance.

### MODEL 2: PANEL DATA REGRESSION

Model 2 measures the same four outcomes, but uses data in slightly different form. Panel data contains measurements on each variable for each year, thereby accounting for the fact that many factors, such as the percentage of students who are eligible for free or reduced-price lunch, may vary considerably from year to year.

This model includes the same control variables as the OLS model, but also includes school and year fixed effects. Year fixed effects account for the influence of statewide trends in the variables. For example, these fixed effects would control for the influence of statewide policy changes that affect all local education agencies equally. School fixed effects, on the other hand, account for differences among schools that are constant over time. These differences include intangible and difficult-to-measure factors such as school culture. By controlling for these influences, we arrive at a more precise estimate of school turnaround's effect on school performance.

## RESULTS<sup>6</sup>

Both models yield evidence that turnaround is associated with significant changes in performance composites and suspension rates. The models produce mixed results for graduation and attendance rates. Table 2 summarizes our results while Tables 3 and 4 provide more detailed analysis.

### MODEL 1

The first model estimates the change in the outcome measures that is associated with turnaround participation. This model generates separate estimates for the 2007 and 2008 cohort schools. During the time period included in the dataset, the 2007 schools were in the turnaround program for three years, and the 2008 schools participated for two years. Thus, if the program is effective, we might expect a larger change in the 2007 cohort schools, which had an additional year to improve, than in the 2008 cohort schools. However, schools in the earlier cohort likely had more chronic problems, which may mean that it is more difficult to achieve gains there. Table 3 summarizes the model's results, with statistically significant changes highlighted in shaded boxes.

**Performance composites:** Model 1 indicates that the school turnaround program is associated with a statistically significant increase in performance composites from 2006 to 2009. After controlling for a variety of school characteristics, performance composites rose, on average, by 7.5 points in the 2007 cohort and by 6.1 points in the 2008 cohort. As expected, the increase is slightly larger in the 2007 cohort, which was in turnaround for one year longer than the 2008 cohort.

**TABLE 2: Summary of model findings regarding turnaround effects**

Outcome	Model 1		Model 2	
	Cohort 1	Cohort 2	Cohort 1	Cohort 2
Performance composite	+	+	+	+
Graduation rate	0	+	0	0
Attendance rate	+	0	0	0
Suspension rate	+	0	+	0

+ indicates statistically significant positive change  
0 indicates no statistically significant change

**TABLE 3: Model 1 estimate of school turnaround effects**

Outcomes	Average change in all schools	Change associated with turnaround participation	
		2007 cohort	2008 cohort
Performance composite	0.7	7.5	6.1
Graduation rate	4.1	-1.7	5.0
Attendance rate	0.26	1.2	0.4
Suspension rate	-0.78	17.2	6.8

Statistically significant effects are highlighted in shaded boxes.

**Graduation rates:** This analysis presents a mixed picture for the effect of turnaround on graduation rates. For the 2007 cohort, the estimated effect was statistically indistinguishable from zero. For the 2008 cohort, turnaround participation is associated with a 5.0 percentage point increase in graduation rates.

**Attendance and suspension rates:** Similarly, the effect of turnaround on attendance and suspension rates is unclear from this analysis. While school turnaround participation was associated with a statistically significant increase in the 2007 cohort, the increase for the 2008 cohort was indistinguishable from zero. However, this may reflect the fact that the 2008 cohort has participated in turnaround for a shorter period of time and the program has not reached its full effect.

While model 1 provides easily interpretable output and controls for a variety of school characteristics, it does not account for many factors that could influence school performance. In particular, the effects of statewide trends or school culture could be conflated with the program effect in this model. This model's results suggest several areas in which the school turnaround program may be effective, but more robust models are needed to reach more confident conclusions.

**MODEL 2**

By incorporating more detailed data and using school and year fixed effects, model 2 arrives at a more reliable estimate of the turnaround program's effectiveness. Once again, the model provides separate estimates for the effect of turnaround in each cohort of schools. The regression output, however, is slightly more complicated to interpret. The coefficients reported in Table 3 indicate the difference, on average, between a school participating in turnaround and a school that is not participating. The estimate does not refer to a specific year, but rather is an average effect for the years that the school participated in turnaround.

**Performance composites:** The analysis from model 2 indicates that for any given school in any given year, if the school was in the 2007 cohort, its performance composite was 4.9 percentage points higher than that of a non-turnaround school. Similarly, a school in the 2008 cohort had, on average, a performance composite that was 4.3 percentage points higher than that of a non-turnaround

school. This effect is slightly smaller than the effect indicated in the OLS model, but is still statistically significant. This association between school turnaround and higher performance composites is robust, as a variety of different model assumptions estimated the effect to be between four and five points.

**Attendance rates:** This analysis indicates that there is no statistically significant relationship between turnaround and attendance rates. Given that attendance is likely an important factor in student achievement, this finding may indicate an area for improvement. It is worth noting, however, that there is very little variation in the attendance rates across the years studied, with most schools reporting rates between 80% and 95%. Even if turnaround did increase attendance rates, the magnitude of that relationship would not be large in size.

**Graduation rates:** The lack of a relationship between turnaround and graduation rates may be explained by the fact that the turnaround program's support from instructional facilitators is targeted toward courses with state exams, most of which are taken during a student's first two years in high school. Thus, we may be observing a situation in which younger students still in high school may reap the benefits of turnaround more than the students who have recently graduated. Graduation rates are a longer-term outcome that may not yet reflect the full impact of turnaround participation.

**Suspension rates:** Model 2 shows a statistically significant relationship between turnaround support and a school's number of short-term suspensions. For the 2007 cohort, receiving turnaround assistance is associated with an increase of 9.2 short-term suspensions per 100 students. For the 2008 cohort, the relationship is smaller and not statistically significant. One can interpret this finding as an indication that discipline problems increased during the time that schools were receiving turnaround assistance. However, another possible explanation is that principals were more willing to address preexisting discipline issues after receiving leadership training. If this explanation is true, the higher number of suspensions may simply be an indication that the administration is moving to create a more disciplined environment. Without more context, it is difficult to determine whether the model's finding is an indication of the program's success.

**TABLE 4: Model 2 estimate of school turnaround effects**

Outcomes	Relationship between outcome measure and school turnaround	
	2007 cohort	2008 cohort
Performance composite	4.9	4.3
Graduation rate	0.1	2.4
Attendance rate	-0.6	0.2
Suspension rate	9.2	1.2

Statistically significant effects are highlighted in shaded boxes.



## CONCLUSION

There does not appear to be a significant relationship between turnaround and school attendance and graduation rates. As we have discussed, the existence of a significant positive relationship between turnaround and the number of short-term suspensions could be interpreted as holding promise for turnaround, or as a marker of increased discipline problems in turnaround schools. Finally, there is a statistically significant positive relationship between turnaround and increases in student performance composites in North Carolina's low-performing high schools. This finding holds promise that gains may continue to be realized as the Department of Public Instruction works to improve the support that it provides to high schools, and the teachers and administrators at turnaround schools put the skills and knowledge they are learning into practice.

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## APPENDIX I: POLICY BACKGROUND

### THE *LEANDRO* CASES AND THE LEGAL PRECEDENT FOR STATE INTERVENTION IN NORTH CAROLINA'S SCHOOLS:

The *Leandro v. North Carolina* case set the stage for state involvement in low-performing schools. The original *Leandro* lawsuit, filed in 1994, was a legal challenge to the state's system of financing public K-12 education. The plaintiffs, parents and students from five low-income rural school districts, claimed that the state education finance system was inadequate and violated students' constitutional right to education.

Lower courts dismissed the lawsuit, but the case was appealed and eventually reached the North Carolina Supreme Court in 1997. In its ruling, the Court established that the State Constitution guarantees equal access to a "sound basic education." The court elaborated that this definition includes

basic skills to function in society, be an informed citizen, prepare for higher education, and be prepared for employment. This first portion of the decision, known as *Leandro I*, further found that the state's education finance system was constitutional (Manning and Wilson, 2002).

After its initial ruling, the Court remanded the case to trial court; Chief Justice Burley Mitchell selected Superior Court Judge Howard Manning to further investigate the state's educational system. Judge Manning held numerous hearings on the matter, and issued rulings on the adequacy of the education provided to students in Hoke County, one of the five school districts named in the case.

After hearing the results of Judge Manning's hearings, the State Supreme Court was prepared to act again, this time in a more aggressive manner. The second ruling in the case,

*Leandro II*, identified early childhood education as an important shortcoming of the system, and mandated that the state provide access to preschool for all at-risk four-year olds <sup>7</sup>.

*Leandro III* declared that low-income students throughout the state were not receiving a sound basic education. Furthermore, the Court required the state and each of its school districts to develop a strategic plan for improving educational outcomes for at-risk students. These plans had to include provisions for the reallocation of resources to ensure that at-risk students receive an adequate education (Manning, 2001).

While the *Leandro* trial may have officially ended, the push for change in North Carolina's schools was far from over. After the trial, Judge Manning continued to play a powerful role in enforcing the *Leandro* rulings. In early 2006, he issued a letter declaring that the state had failed to make sufficient progress in turning around low-performing schools. In response, he identified a list of "priority" high schools that had demonstrated persistently low achievement scores. The percent composite at each of these seventeen high schools was below 55 percent in the 2005-2006 school year, and it had been below 55 percent for the previous four years. Then-Governor Michael Easley added eighteen additional high schools to Judge Manning's list; each of the Governor's additions was a school with a performance composite below 60 percent for two consecutive years (North Carolina Department of Public Instruction, 2010c).

Together, these thirty-five high schools were the first cohort to enter the Department of Public Instruction's newly minted "school turnaround" program. The Department departed from the efforts of the State Assistance Teams in place during the early 1990s. Those teams had helped struggling schools design plans for reform, then trained teachers and administrators to implement the changes. Thirty additional high schools entered turnaround in 2007-2008 because each had a performance composite below 60 for two consecutive years (North Carolina Department of Public Instruction, 2010c). Sixty-five high schools were now receiving intensive support from the state <sup>8</sup>.

#### **"ACADEMIC GENOCIDE" IN HALIFAX COUNTY SCHOOLS:**

It is important to note that the Department of Public Instruction's school and district transformation team is involved in one school district because of a court order. In 2009, following up on his vow to re-structure failing schools, Judge Manning ordered a hearing to determine who should run Halifax County Schools. He chose Halifax for several reasons, chief among them that the district's graduation rate was the lowest in the state. In addition, the judicial proceeding cited a lengthy list of other academic shortcomings. Seven of the district's sixteen schools were designated by the state

as continually low-performing. In the past four years, neither of the high schools in Halifax County reported an End-of-Course performance composite of over 40 percent. Finally, none of the district's schools were making adequate yearly progress as defined by the No Child Left Behind Act. Based on this evidence, Judge Manning declared that the district was depriving students of their right to equal access to a sound basic education. He characterized the schools' abysmal record as "academic genocide" (Waggoner, 2010).

In addition to these well-documented academic failures, Halifax County Schools has suffered from poor financial management. The district is currently repaying more than \$1 million in state loans that it incurred as a result of overspending and financial mismanagement (Minnick, 2010). This widespread perception of academic and administrative failure was confirmed by Judge Manning's hearing. As a result, he ordered increased state oversight of Halifax County Schools. He directed the state Department of Public Instruction to come up with a plan to be approved by the Halifax Board of Education, the State Board of Education, and Judge Manning himself. The Department of Public Instruction developed a three-year plan for state intervention, to which all parties agreed through a consent order (Ashley, 2010).

Under the consent order, the Halifax County Board of Education agreed to share information with the turnaround team regarding personnel, finance, curriculum, instruction, and student achievement. In addition, they agreed to hear the turnaround team's advice, though the consent order does not require compliance. However, should the Halifax School Board refuse to implement any state recommendations, they would be called into a hearing to explain their rationale (North Carolina Wake County Superior Court Division, 2009). No disagreements between Halifax and state have yet progressed to that stage.

In accordance with the consent order, the Department of Public Instruction's Director of the Division of District and School Transformation consults with members of the Halifax County Board of Education. The Department of Public Instruction also mandated that Halifax County Schools select experienced and successful teachers to serve as instructional coaches in math and reading. These coaches plan professional development sessions for teachers and observe in classrooms. While they provide informal feedback to teachers, they do not complete the formal observations that play a role in re-hiring decisions. Lastly, the district and its schools receive the same support as other local education agencies in school and district transformation (Ashley, 2010).

<sup>7</sup> The State Supreme Court eventually overturned the preschool mandate, though the legislature did expand preschool programs in response to the ruling.

<sup>8</sup> The Department of Public Instruction began to provide support to middle schools during the 2007-2008 school year. Middle schools entered turnaround because they met two criteria: their composite performances on End-of-Grade tests in Reading Comprehension, Mathematics, and Science were below sixty percent, and the schools were "feeder institutions" for high schools previously identified for turnaround assistance. In addition, twenty elementary schools received services from the turnaround program for the 2007-2008 school year only. The Department of Public Instruction selected elementary schools for support on the basis of their status under No Child Left Behind and the ABC accountability system (North Carolina Department of Public Instruction, 2010c). In this report, we limited our analysis to high schools, the initial recipients of turnaround assistance.

## APPENDIX II: DESCRIPTION OF TURNAROUND SERVICES

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High schools in turnaround must meet two state mandates, but they also have access to comprehensive support from the Department of Public Instruction. Each high school must complete a Framework for Action document that outlines the plan that the school, district, and community will undertake to improve performance. Specifically, the document must detail the school's plans for ninth grade transition, formative assessment, specialized assistance for struggling students, literacy improvement, professional development, design of more efficient school policies and procedures, community involvement in the school, establishment of professional learning communities in which teachers share knowledge and best practices, and the choice of a redesign plan (Trenholme, 2007).

This last requirement references another mandate for high schools in turnaround: schools must select a comprehensive reform model to restructure the school. The Department of Public Instruction offers schools four choices: the N.C. New Schools Project, America's Choice, Talent Development High Schools, or a self-designed reform model. America's Choice and Talent Development High Schools are non-profit organizations that contract with school districts throughout the United States to restructure and reform failing schools; the N.C. New School Project does so only with schools in this state. Any school that chooses to create its own redesign plan must submit the plan to the Department of Public Instruction for review and approval (Trenholme, 2007).

Schools in the turnaround program have access to a series of management and curricular resources from the Department of Public Instruction. For schools with performance composites below 50 percent, the Department of Public Instruction sends staff to complete a comprehensive needs assessment. These trained staff members observe in a school and meet with stakeholders, including teachers and administrators. They then use a rubric to rate the school as "leading, developing, emerging, or lacking" on six dimensions: school expectations and curriculum, student achievement and support for students, leadership, teacher quality and development, resources and facilities, and family and community engagement. The comprehensive needs assessment process helps schools to identify their strengths and areas for improvement, as well as establish a process for internal review in the future. Frequently, schools are able to use the results of the assessment to revise their Framework for Action plans (Department of Public Instruction, 2010a).

In addition to the staff who visit the school to conduct the comprehensive needs assessment, the Department assigns a trained leadership facilitator to each school; this individual works directly with the principal to effect immediate change, including the creation of a standardized discipline policy and enhanced expectations for teachers and students. Principals also receive intensive professional development during the summer and

school year. Lastly, the Department of Public Instruction employs instructional facilitators who travel to turnaround schools and work with math, science, English, and social studies teachers to develop classroom materials and improve instruction (North Carolina Department of Public Instruction, 2010c).

After one year of providing turnaround support to low-performing high schools, the Department of Public Instruction re-envisioned its High School Turnaround Office as a more expansive set of supports. The Department created a new division, the District and School Transformation division, and partnered with five local education agencies (Bertie County, Columbus County, Hertford County, Lexington City, and Richmond County) to improve education in those areas. The Department and the local education agencies agreed to reform not only the central office administration in each locality, but also to strengthen each school within those local education agencies.

A local education agency in district transformation first works with the Department of Public Instruction to set goals for improvement at each of its schools. The Department of Public Instruction then delegates specific staff positions to serve in the partnering school systems; these individuals work for the Department but spend each day in the local communities. A District Transformation Coach works at the central office to assist the superintendent, and each school principal receives assistance from one of several School Transformation Coaches (one for elementary schools, one for middle schools, and one for high schools). Lastly, the same instructional facilitators who support teachers in turnaround schools provide coaching for teachers in partnering districts (North Carolina Department of Public Instruction, 2010b).

## APPENDIX III: DATA

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We obtained information on the following variables from the North Carolina School Report Card database: percent composite, school enrollment, percentage of teachers who are fully licensed, number of short-term suspensions (per 100 students), attendance rate, and percentage of students who are eligible for free or reduced-price lunch. We obtained data on graduation rate and the percentage of the student body that is non-white from the Department of Public Instruction website. Lastly, the Division of School and District Transformation provided information on whether a high school received turnaround support and whether a high school's local education agency received district transformation support

## APPENDIX IV: METHODOLOGY

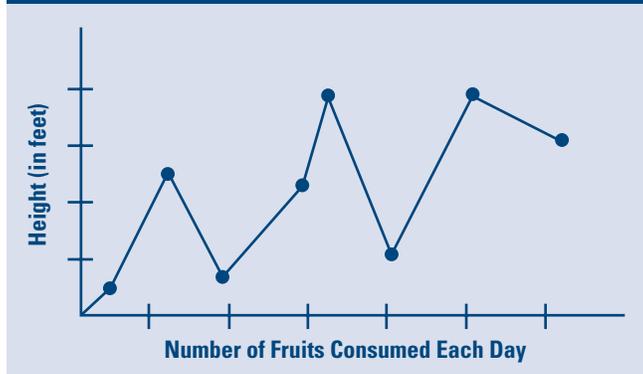
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### EXPLANATION OF LINEAR REGRESSION:

For illustrative purposes, we begin by offering a simple statement for evaluation. Eating more fruit makes children grow taller. A linear regression model allows us to explore the relationship between a predictor variable (in this case, the daily amount of fruit consumed)

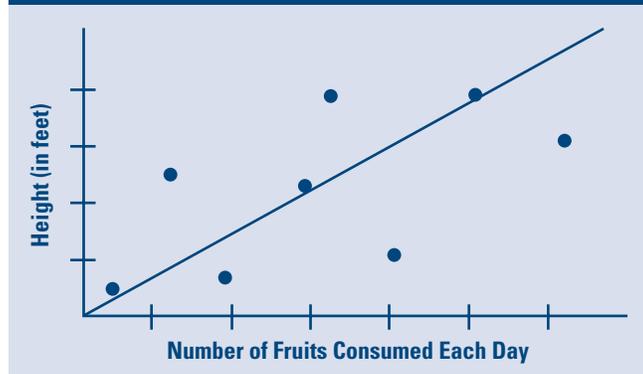
and an outcome variable (here, height of a child). One common way to visualize such a relationship is to create a graph.

**FIGURE 1: Simple Graph of the Relationship between the Daily Consumption of Fruits and Height**



With all the data points on the graph, it is difficult to see the relationship between fruit consumption and height. When we ignore the lines connecting the points, it looks like there is a positive relationship, that is, eating more fruit is associated with greater height. To see this relationship more clearly, we can draw a straight line that is fairly close to all the points.

**FIGURE 2: Simple Graph of the Relationship between the Daily Consumption of Fruits and Height**



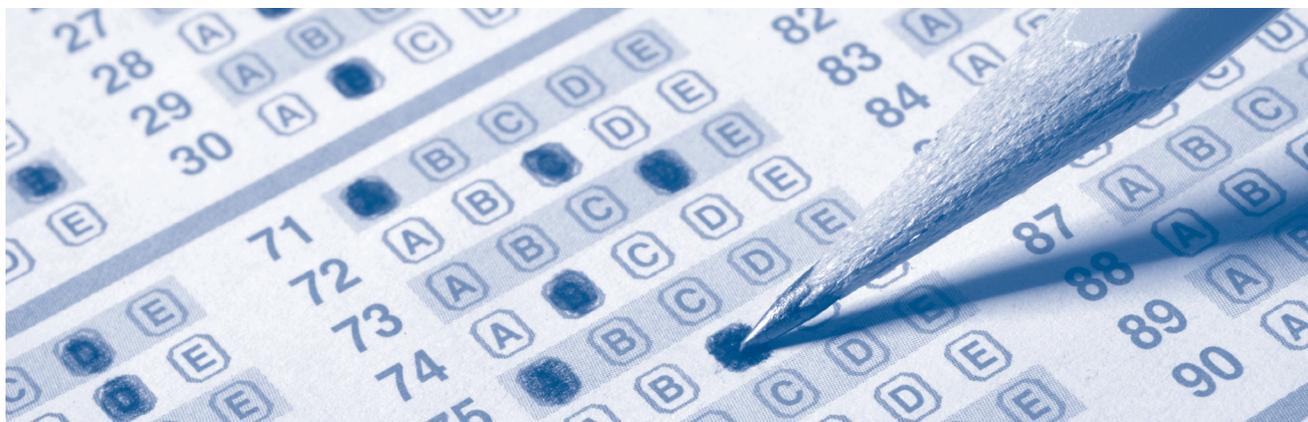
This graph more clearly shows that there is a positive relationship between the two.

A linear regression model follows the same basic steps. A statistical software package (such as STATA or SAS) is used to plot a large number of data points, then to draw a line that best fits the overall relationship. The software then calculates the slope of this line, which represents the numerical relationship between the predictor variable and the outcome variable. Let us offer that the slope on our line from Figure Two is .75. This value would indicate that eating one additional fruit each day is associated with an additional .75 feet in growth (above the height that we would normally expect a child to have).

The use of statistical software allows us to consider predictor and outcome variables that are not numerical. In this analysis, our predictor is measured with a “yes” or a “no,” either the school is receiving turnaround support or it is not. This type of variable is referred to as a binary variable. Our various outcome measures are numerical, ranging from zero to one hundred; these types of variables are called continuous variables.

In our scenario with fruit consumption and height of children, it is easy to imagine many other factors that affect how tall a child becomes, for example, the height of his parents and his consumption of necessary vitamins and nutrients. But let us suppose that we are only concerned with the effect that fruit has on a child’s height; how do we eliminate the effect that genetics and nutrition have on height? We can use a statistical software package to “control” for genetics and nutrition if we have measurements on children’s genetics (for example, the height of their tallest parent) and nutrition (the amounts of various vitamins consumed per day). If we “control” for them when graphing the relationship between fruit consumption and height, the slope effectively measures the effect of fruit consumption on height with genetic and nutritional effects completely removed from the mix.

Our linear regression analysis controls for various factors that can affect student achievement, including changes in school leadership, the percentage of fully licensed teachers at a school, and school demographics, including size and the percentage of students who are eligible for free and reduced-price lunch. By using statistical controls, we are able to isolate the effect of the Department of Public Instruction’s turnaround services on student achievement measures.



## MODEL 1: OLS Longitudinal Data Regression Models

$$PC_{\text{gain}} = \beta_0 + \beta_1 ST1 + \beta_2 ST2 + \beta_3 DT + \beta_4 POP + \beta_5 FLT + \beta_6 FRL + \beta_7 ATT + \beta_8 SUSP + \beta_9 NW + \epsilon$$

$$GRAD_{\text{gain}} = \beta_0 + \beta_1 ST1 + \beta_2 ST2 + \beta_3 DT + \beta_4 POP + \beta_5 FLT + \beta_6 FRL + \beta_7 ATT + \beta_8 SUSP + \beta_9 NW + \epsilon$$

$$ATT_{\text{gain}} = \beta_0 + \beta_1 ST1 + \beta_2 ST2 + \beta_3 DT + \beta_4 POP + \beta_5 FLT + \beta_6 FRL + \beta_7 NW + \epsilon$$

$$SUSP_{\text{gain}} = \beta_0 + \beta_1 ST1 + \beta_2 ST2 + \beta_3 DT + \beta_4 POP + \beta_5 FLT + \beta_6 FRL + \beta_7 NW + \epsilon$$

Where

- PCgain = 2009 school performance composite – 2006 performance composite
- GRADgain = 2009 graduation rate – 2006 rate
- ATTgain = 2009 attendance rate – 2006 rate
- SUSPgain = 2009 short-term suspension rate – 2006 rate
- ST1 = school participated in turnaround program beginning in 2006-2007 school year
- ST2 = school participated in turnaround program beginning in 2007-2008 school year
- DT = school's LEA participated in District Transformation (0,1)
- POP = school enrollment (continuous, measured in 100's of students)
- FLT = % of teachers who have full licensure (0-100)
- FRL = % of students eligible for free or reduced lunch (0-100)
- ATT = attendance rate (0-100)
- SUSP = number of short-term suspensions (per 100 students)
- NW = % of student body that is nonwhite (0-100)
- $\epsilon$  is the error term

## MODEL 2: Panel Data Regressions Models

$$PC_{it} = \beta_0 + \beta_1 ST1_{it} + \beta_2 ST2_{it} + \beta_3 DT_{it} + \beta_4 POP_{it} + \beta_5 FLT_{it} + \beta_6 FRL_{it} + \beta_7 ATT_{it} + \beta_8 SUSP_{it} + \beta_9 NW_{it} + \alpha_i + \gamma_t + \epsilon_{it}$$

$$GRAD_{it} = \beta_0 + \beta_1 ST1_{it} + \beta_2 ST2_{it} + \beta_3 DT_{it} + \beta_4 POP_{it} + \beta_5 FLT_{it} + \beta_6 FRL_{it} + \beta_7 ATT_{it} + \beta_8 SUSP_{it} + \beta_9 NW_{it} + \alpha_i + \gamma_t + \epsilon_{it}$$

$$ATT_{it} = \beta_0 + \beta_1 ST1_{it} + \beta_2 ST2_{it} + \beta_3 DT_{it} + \beta_4 POP_{it} + \beta_5 FLT_{it} + \beta_6 FRL_{it} + \beta_7 NW_{it} + \alpha_i + \gamma_t + \epsilon_{it}$$

$$SUSP_{it} = \beta_0 + \beta_1 ST1_{it} + \beta_2 ST2_{it} + \beta_3 DT_{it} + \beta_4 POP_{it} + \beta_5 FLT_{it} + \beta_6 FRL_{it} + \beta_7 NW_{it} + \alpha_i + \gamma_t + \epsilon_{it}$$

Where

- $PC_{it}$  = performance composite of school i in year t (0-100)
- $GRAD_{it}$  = graduation rate (0-100)
- $ST1_{it}$  = school participated in first school turnaround cohort in year i (0,1)
- $ST2_{it}$  = school participated in second school turnaround cohort in year i (0,1)
- $DT_{it}$  = school's LEA participated in District Transformation in year i (0,1)
- $POP_{it}$  = school enrollment (continuous, measured in 100's of students)
- $FLT_{it}$  = % of teachers who have full licensure (0-100)
- $FRL_{it}$  = % of students eligible for free or reduced lunch (0-100)
- $ATT_{it}$  = attendance rate (0-100)
- $SUSP_{it}$  = number of short-term suspensions (per 100 students)
- $NW_{it}$  = % of student body that is nonwhite (100)
- $\alpha_i$  represents school fixed effects
- $\gamma_t$  represents year fixed effects
- $\epsilon_{it}$  is the error term

## APPENDIX V: RESULTS

APPENDIX TABLE 1: Model 1 Results. OLS Longitudinal Data Regressions

	Perf. Comp. Gain	Grad Rate Gain	Attend. Rate Gain	Short-term Susp Rate Gain
	Coefficient (std error)	Coefficient (std error)	Coefficient (std error)	Coefficient (std error)
School turnaround cohort 1 participant (0,1)	0.075** (0.020)	-1.665 (2.144)	1.244** (0.412)	17.200** (6.069)
School turnaround cohort 2 participant (0,1)	0.061** (0.018)	4.970** (1.885)	0.394 (0.363)	6.786 (5.386)
District turnaround (0,1)	-0.021 (0.031)	6.227* (3.155)	-0.620 (0.629)	-14.552 (9.150)
Enrollment (100 students)	0.002* (0.001)	-0.310** (0.100)	-0.096** (0.018)	0.597* (0.288)
% fully licensed teachers	-0.001 (0.001)	-0.061 (0.093)	-0.011 (0.017)	-0.158 (0.254)
% FRL eligible	-0.001** (0.000)	-0.075 (0.040)	-0.023** (0.007)	-0.143 (0.110)
% student body nonwhite	-0.000 (0.000)	0.025 (0.029)	0.008 (0.005)	0.055 (0.076)
Attendance rate	0.001 (0.001)	0.069 (0.107)	–	–
Short-term suspension rate	-0.000 (0.000)	-0.022 (0.023)	–	–
Adj. R-squared	0.081	0.055	0.088	0.043

\* p-value<0.05; \*\* p-value<0.01

**APPENDIX TABLE 2: Model 2 Results. Panel Data Regressions**

	Perf. Comp.	Grad. Rate	Attend. Rate	Short-term Susp. Rate
	Coefficient (std error)	Coefficient (std error)	Coefficient (std error)	Coefficient (std error)
School turnaround cohort 1 participant (0,1)	4.916** (1.060)	0.078 (1.391)	-0.623 (0.602)	9.166** (3.092)
School turnaround cohort 2 participant (0,1)	4.318** (0.965)	2.447 (1.265)	0.202 (0.551)	1.188 (2.828)
District turnaround (0,1)	0.357 (1.673)	0.640 (2.260)	1.488 (0.954)	-0.323 (4.896)
Enrollment	0.112 (0.147)	0.181 (0.223)	0.668** (0.081)	0.488 (0.418)
% fully licensed teachers	0.034 (0.030)	0.016 (0.049)	0.212** (0.016)	0.151 (0.082)
% FRL eligible	-0.041 (0.022)	-0.050 (0.038)	0.152** (0.012)	0.073 (0.061)
% student body nonwhite	-0.064** (0.023)	0.014 (0.034)	-0.010 (0.013)	-0.133 (0.068)
Attendance rate	0.075 (0.051)	-0.065 (0.075)	-	-
Short-term suspension rate	-0.026* (0.010)	-0.021 (0.016)	-	-
Adj. R-squared	0.868	0.651	0.574	0.841
School fixed effects?	Yes	Yes	Yes	Yes
Year fixed effects?	Yes	Yes	Yes	Yes

\* p-value<0.05; \*\* p-value<0.01



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By Joel McFarland and Jennifer Preston

The Financial and Business Services Area is in its fourth year of the Research Intern Program. The Program is designed to help build a quality research program within DPI to supplement and supply data for discussions related to procedural, process, and policy changes. This year's program included students from the Duke University master's program in Public Policy, a graduate of the University of North Carolina at Chapel Hill master's program in Public Administration, and a doctoral student from North Carolina State University in Public Administration. The intern program is managed by Christi Chadwick (919-807-4029) and Kayla Siler (919-807-3824) | [intern\\_research@dpi.state.nc.us](mailto:intern_research@dpi.state.nc.us)

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