Assessing the Effectiveness of Tennessee's Pre-Kindergarten Program: Annual Report 2008-2009

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Foreword and Acknowledgements

This Annual Report, produced under contract with the Tennessee State Comptroller's Office, provides additional background, context, and supplemental analyses to accompany the results of a longitudinal analysis of student outcomes for students who participated in Tennessee's Pre-K program between 1998-1999 and 2005-2006. Statistical analyses have explored the short- and long-term impact of Pre-K participation on student assessments in Kindergarten through Fifth Grade. This report supplements previous reports and aims to clarify a number of outstanding research questions identified after review of the Second Interim Report.

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Executive Summary

The State of Tennessee has commissioned an evaluation of the effectiveness of its Pre-Kindergarten (Pre-K)[1] program through a secondary data analysis (i.e., analysis of existing data) of student outcomes comparing Pre-K participants to a comparison group of students who did not attend state-funded Pre-K. The primary objective of the project is to assess whether children who attended a Tennessee-funded Pre-K program perform better academically in the short and long term than a comparable group of peers who did not attend Tennessee's Pre-K program, and what measurable characteristics of Pre-K programs impact student academic outcomes in the short- and long-term.

The primary objective of this 2008-2009 Annual Report is to review the results to date and to clarify and extend the analyses and findings presented in the evaluation's Second Interim Report in July, 2008. Specifically, the Second Interim Report consisted of a general analysis of student achievement as measured by results of standardized tests administered in three academic years (2004-2005, 2005-2006, and 2006-2007).

A review of conceptually similar studies investigating the impact of Pre-K programs on student outcomes shows that Pre-K programs create an opportunity to stimulate growth and development at a critical period in child development. Children who respond to this intervention are then positioned to learn more quickly and to potentially carry this advantage further in their educational careers—although the literature is fairly clear that the intervention is limited in its impact, and the duration of this potential advantage remains unclear. Consistent with the results of the present evaluation, many studies find improved language or math skills in Kindergarten following Pre-K, but these effects have often dissipated by the First or Second Grade. Thus, the findings of this evaluation to date are consistent with what has been found in both academic and applied research on the subject of Pre-K effectiveness across the country over the last 20 years.

In an effort to include as many students as possible in the analysis, data files were re-examined, and it was discovered that a large number of Pre-K cases which had been excluded from previous analyses due to missing or incomplete data could be cleaned and captured for inclusion in the models. Including these cases increased substantially the power and the validity of the statistical tests, but changed only slightly the pattern of results observed and reported in the Second Interim Report.

As found previously, on end-of-year assessments administered in Kindergarten, Pre-K students scored better, in the aggregate, than a matched sample of non-Pre-K students. These effects are most clear for economically disadvantaged students (i.e., students receiving FRPL), and there is some evidence that the effects for these students persist through the second grade, although the magnitude of the effect is objectively small (a relative difference of between 4-7 points, a difference of less than 0.1 standard deviation). Consistent with previous analyses conducted for this annual report, Pre-K participation was not in itself a significant predictor of student performance on assessments in First or Second Grades, and none of the aggregated Pre-K/Non-Pre-K comparisons indicated a significant effect of Pre-K. Again, among economically disadvantaged students, there were several small but statistically significant effects associated with Pre-K participation that appear to persist into First and Second Grades.

Additional analyses were conducted to explore potential sources of bias in the results due to sampling or analytic techniques. Specifically, selecting non-Pre-K students at higher grades, and trying to

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[1] Throughout this report, the term "Pre-Kindergarten and its abbreviation "Pre-K" are used to refer specifically to Tennessee's state-funded Voluntary Pre-Kindergarten program and not any other type of early childhood education program. The term "non-Pre-K" is used to refer to students who did not attend Tennessee's Pre-K program, although they may have participated in other early childhood education programs.

reconcile incomplete records (particularly among students in Kindergarten – Second Grade) may have obscured the unique effects of Pre-K, especially at higher grades. However, additional analyses conducted only with students who were matched at the earliest time point possible (i.e., in Kindergarten), and only with students who have complete assessment records produced similar results as those found in the overall sample, leading us to conclude that these potential sources of bias do not compromise the findings from the Second Interim Report. The largest and most reliable effects of Pre-K participation are found in Kindergarten. This suggests that the Pre-K program is meeting its objectives in terms of effective preparation for formal schooling or increasing "school readiness," but that the unique effects of Pre-K on academic achievement appear to diminish over time, as observed in other national and state-specific studies of Pre-K programs.

Another consideration we investigated following the Second Interim Report was the program expansion and curricular alignment in the 2005-2006 Pre-K program year. Given that the Pre-K program experienced a number of fundamental changes in this year, most notably an alignment to Kindergarten standards, a relevant question that emerged was whether students who participated in the aligned Pre-K program performed better on Kindergarten assessments compared to students who participated in Pre-K prior to alignment. Although only one year of Kindergarten assessment data was available for this report to address this question, a new analysis compared Kindergarten assessment results for Pre-K participants pre- and post-alignment. However, this analysis revealed no significant difference in the first year of alignment. This is an issue that will continue to be investigated in future evaluation reports.

Given that few Tennessee school systems conduct assessments in Kindergarten, another relevant question that emerged in discussion of the results of the Second Interim Report was whether the nature of the schools represented in the analyses could introduce a potential source of bias. Using indicators from the National Center for Education Statistics (NCES) and the US Census, we found few systematic differences between school systems that assessed versus those that did not assess in Kindergarten through Second Grade. There were some differences in terms of the percentage of students receiving free/reduced price lunch (an indicator of economic disadvantage) and the percentage of minority/non-white students in school systems that conducted assessments. These differences, while acknowledged, do not pose a significant threat to the interpretation of the results of the present evaluation, given that FRPL is a known risk factor that was incorporated into the design as a control variable. Further, student race was also identified as a potential risk factor in the Second Interim Report and statistical controls were also built into the design to account for potential differences due to race and gender. Still, all statistical models were re-run including as covariates data describing the school system's urban-centric locale, percent of children receiving FRPL, percent of minority/nonwhite students in the district, and total expenditures per student (variables from NCES), as well as the median household income in the district and the percent of children living in poverty in the district (variables from the 2000 Census, obtained from NCES). The results of the Pre-K/non-Pre-K comparisons were virtually unchanged, although differences that had emerged in the Second Grade did not reach significance after incorporating these covariates. This suggests that the unique effects associated with Pre-K participation may be more reliably observed in Kindergarten and First Grade, but there is overall little evidence in the present evaluation that these effects last beyond First Grade.

Pre-K curricula vary across programs, and as such we also explored the number and types of curricula used in the Pre-K program. In this report we present a descriptive analysis linking the types of curriculum used at Pre-K sites in 2004-2005 and 2005-2006 to the number of Pre-K students at these sites for whom we have valid[2] records. We found that although Creative Curriculum was, by far,

[2] For purposes of this report, a "valid" record contained an encrypted social security number (ESSN), had no anomalies in the record that could not be resolved, and no differences in demographic information between data sources (Pre-K student information file, TDOE assessment record, or TDOE EIS record) that could not be resolved.

the most commonly used curriculum in both years, there was great variation in the types of Pre-K curriculum used statewide.

Objectives of the Present Annual Report

This report, Annual Report 2008-2009, reviews the results of this evaluation to date and provides additional exploratory analyses of Pre-K and assessment data for academic years 2004-2005, 2005-2006, 2006-2007. As specified by the RFP, and in consultation with the Office of Early Learning, the present report seeks to further clarify and extend the findings presented in the evaluation's Second Interim Report in July, 2008. Specific objectives include:

- Provide a review of relevant literature to address other findings from conceptually similar investigations exploring the impact of Pre-K participation on academic achievement.
- Summarize the findings of this evaluation to date over two Interim Reports.
- Explore potential sources of bias due to methodological issues in the Second Interim Report, in particular, whether sampling techniques to select students who did not participate in Pre-K may have created a potential source of bias in the results.
- Explore evidence to determine whether Tennessee's Pre-K program is meeting its objectives in terms of school readiness; that is, do Pre-K participants perform better in Kindergarten, specifically, than students who did not participate in the Voluntary Pre-K program?
- Identify any potential impact of Pre-K curricular revisions in the 2005-2006 academic year; specifically, to examine whether Pre-K participants who took part in the program after the 2005 curricular alignment fare better on Kindergarten assessments than children who participated in Pre-K prior to alignment.
- Incorporate descriptive information about school systems from the National Center for Education Statistics (NCES) to explore the characteristics of school systems attended by Pre-K participants and the characteristics of school systems that administer assessments in Grades K-2, and, if possible, control for these characteristics in the comparisons of Pre-K and non-Pre-K students.
- Explore the types of curricula used in Pre-K programs; the prevalence of each and the number of Pre-K students exposed to each type.
- Examine changes in prevalence and exposure pre- and post-curricular alignment (2004-2005 and 2005-2006).

A Review of Efforts to Evaluate the Impact of Pre-Kindergarten Programs: Methods, Measures, and Findings

What is the purpose of Pre-Kindergarten? How does one measure whether Pre-K programs are effective, and how does one capture the degree of their effectiveness? These are all pertinent questions in the context of the present evaluation. Many studies ranging in depth, complexity, and variety of research questions have been mounted using a range of methodologies and measures. Therefore, it seems appropriate to include in this annual report a brief review of relevant literature and the results of other conceptually relevant evaluations of Pre-K programs.

To assess the impact of the Tennessee Voluntary Pre-K program, it is important to bear in mind the overarching objectives of Tennessee's program:

- To provide Tennessee's 4-year-old children with the learning experiences they need in order to succeed in kindergarten.
- To prepare children for school by providing an opportunity for them to develop school readiness skills in an environment that fosters the love and joy of learning.
- To help children develop pre-academic and social skills that will help them in their educational career.[3]

In Tennessee and across the country, Pre-Kindergarten programs are intended to prepare a child for successful entry into Kindergarten so that he or she is prepared with a foundation upon which cognitive, social, developmental, and behavioral skills can be built. Indeed, the term "Pre-Kindergarten" suggests a type of program qualitatively different from a more general "preschool" or child care program because of its specific intent to develop in participating children the specific skills necessary for success in Kindergarten.[4] Research from many academic and applied domains clearly shows that children who begin school with strong literacy skills, phonological awareness, and mathematical knowledge fare better in reading and mathematics later on in school.[5] Pre-K programs in many states, including Tennessee, now target "at-risk" populations in the hopes of closing persistent "achievement gaps" and reducing disparities in student achievement in higher grades. However, the extent to which an intervention like Pre-K can close these gaps in broad, statewide implementation is a question which remains unanswered.

Since the 1960s, Pre-K programs have been a widely discussed topic in the policy and education arenas alike as a potential mechanism to intervene with children "at risk" of poor educational outcomes during their early childhood years. In recent years there has been a veritable explosion of research on this topic. Findings from this growing body of evidence vary, however; results range from suggesting that Pre-K has little to no effect to indicating that Pre-K has a host of long-term positive effects—including academic achievement, reductions in delinquent activity, and higher lifetime earnings. Research also suggests that there is a particular potential advantage of Pre-K participation among minority populations and children considered "at-risk" for poor educational attainment due to low socioeconomic status (SES) or other factors.[6]

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[3] Source: http://tn.gov/education/prek/

[4] Waldfogel. J. (2006). *What Children Need*. Cambridge, MA: Harvard University Press.

[5] Preschool Curriculum Evaluation Research Consortium (2008). *Effects of Preschool Curriculum Programs on School Readiness* (NCER 2008-2009). Washington, DC: National Center for Education Research, Institute of Education Sciences, U.S. Department of Education. Washington, DC: U.S.Government Printing Office. http://ncer.ed.gov.

[6] Ibid.

Indeed, the risks associated with economic disadvantage are not to be underestimated; socioeconomic status is widely acknowledged as one of the strongest and most reliable predictors of poor academic skills upon a child's entry into school.[7] Tennessee's program, like many others, gives priority to economically disadvantaged students or children otherwise identified "at risk." This population includes children from low-SES households (i.e., students who qualify for free or reduced-price lunch programs), children who have disabilities, children who are English Language Learners, children who are in state custody, or children who are at risk due to abuse or neglect.[8] In Tennessee, children meeting these criteria are given priority to access the Pre-K program, with the hope that participation in the early intervention afforded by Pre-K will bridge or eliminate potential gaps in student achievement, improving their "readiness" to learn once they enter school at Kindergarten.

Many studies claim that Pre-K improves "school readiness" but the definition of "readiness" can be so broad as to be rendered almost uninterpretable. In one recent study, for example, "readiness" was defined as encompassing "physical well-being and motor development, social and emotional development, cognitive general knowledge, approaches to learning, and language development." [9] Of particular note are the many developmental indicators of "readiness" beyond academic skills, including (but not limited to) communication and social skills, health, social behaviors, and motivation to learn. [10, 11] Although these are all valid ways of interpreting "school readiness" it is important to note when evaluating the claims made by researchers and evaluators alike that operational definitions do not always agree. Further complicating matters, across the literature, data regarding these additional—yet arguably equally important—indicators of readiness are sparse and unstandardized, making the results observed in studies where these outcomes are measured difficult to interpret. It is therefore unsurprising that many evaluations focus solely on academic indicators. The present study is no exception, focusing exclusively on standardized assessments administered to all students in Grades 3-5 as well as assessments administered in some schools in Kindergarten through Second Grade.

An increasingly vast number of studies address the question of how early childhood education impacts both school readiness and, later on, children's test scores in higher grades. To provide context for interpreting the results observed in the present evaluation, it is important to highlight evidence from methodologically and conceptually similar studies. A review of this literature identifies three dominant themes: 1) high-quality Pre-K programs prepare children for success in Kindergarten, 2) early childhood educational interventions like Pre-K are viewed as a means of closing gaps in achievement such as that observed for disadvantaged and non-disadvantaged children, but 3) over time, the effects of Pre-K are increasingly confounded by external influences, and evidence of long-term widespread benefits associated with Pre-K is slim.

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[7] Sadowski, M. (2006). The School Readiness Gap. *Harvard Education Letter,* 22(4), 4-7. http://www.edletter.org/past/issues/2006-ja/readinessgap.shtml

[8] According to the Tennessee Department of Education, Office of Early Learning, "first priority is given to children who meet federal free/reduced price lunch (FRPL) guidelines and are four years old by September 30. If space is available after enrolling children who qualify for FRPL, the program may enroll children who have disabilities, are English Language Learners, are in state custody, or who are at risk due to abuse or neglect, regardless of income. If space is still available after the first 20 days of the new school year, the LEA can submit a request to the Office of Early Learning to enroll all other children at that time." (http://www.tennessee.gov/education/earlylearning/doc/OEL_FAQs.pdf, downloaded from the Internet in March 2009).

[9] U.S. Department of Education, National Center for Education Statistics (2003). *Prekindergarten in U.S. Public Schools: 2000–2001,* NCES 2003-019, (Smith, T., Kleiner, A., Parsad, B., and Farris, E.). Washington, DC.

[10] Magnuson, K A. and Waldfogel. J. (2005). Early Childhood Care and Education: Effects on Ethnic and Racial Gaps in School Readiness. *The Future of Children*, 169-196.

[11] Shonkoff, J P. and Philips, D. (Eds.) (2000). *From Neurons to Neighborhoods: The Science of Early Childhood Development*. Washington: National Academy Press.

The following review highlights evidence that documents these three trends. It is important to take into consideration not only a particular study's findings and conclusions, but also the methodology of the study and the approach taken to address the research question(s) of interest. Methodological decisions are made for both reasons of practicality and feasibility. A study's methodology enables or constrains it to be able to answer a particular question, and for that reason it is relevant to review not only a number of studies that speak to the effectiveness of Pre-K programs but also to review the approach taken by the researchers—as well as the metrics and measures used to determine "effectiveness." Therefore, in the following section evidence is presented from a range of studies and important methodological considerations are addressed.

1. Benefits of Pre-K Participation on School Readiness

It seems fairly intuitive that the skills children possess when entering Kindergarten might result in different patterns of achievement over time. If learning is thought of as a sequential process, then starting school with a strong set of skills helps children to master more advanced skills at an earlier age; following with this logic, a child who masters more advanced skills earlier has greater potential to achieve at higher levels over the same amount of time compared with a child who enters school without those same fundamental skills.[12] Still, evaluating the impact of large-scale Pre-K programs is a difficult task. Individual differences in student outcomes and differences in program implementation across sites may be difficult to capture (if they can be captured at all). Notwithstanding, a number of Pre-K programs have identified benefits in terms of participants' school readiness (as measured prior to Kindergarten entry).

An evaluation of Tulsa, Oklahoma's city-wide Pre-K program examined the standardized test results of a sample of 3,560 students beginning Kindergarten and Pre-K in the 2001-2002 school year.[13] A regression-discontinuity design (RDD) was used in this particular study. RDD is a method of analysis often used in policy research that measures the average effect of an intervention by defining a cut-off point (i.e. a specific date) imposed based upon a particular characteristic of the population of interest. RDD then involves analyzing differences between a sub-population that did not receive the intervention and one that did based upon a selected cut-off date. In this study, a firm birthday cut-off was used, creating two groups of students that were approximately the same age (give or take a certain number of days) relative to the birthday cut-off date. For example, if November 15th were selected as the birthday cut-off, a child born on November 14th who was turning age 5 would be in the slightly older group, and a child born on November 16th who was turning age 5 would be in the slightly younger group. In this study, the slightly older students were beginning Kindergarten and had already completed their Pre-K experience. The slightly younger students were beginning Pre-K and made up the non-intervention group as they had not completed their Pre-K experience. A 26-item standardized test was administered to students at the beginning of Pre-K and the beginning of Kindergarten (the exam was administered to both groups of students). The study found that the Tulsa Public School (TPS) Pre-K students significantly outperformed the non-Pre-K students on this standardized measure by 5-7 points—0.39 of a standard deviation (SD) in cognitive measures, 0.24 SD in fine motor skills, and 0.38 SD in language skills. Greater impacts were seen for ethnically diverse children (Hispanic children in particular) and for economically disadvantaged children. A limitation of the results, however, is the fact that the evaluators could not conclusively determine whether "non-TPS Pre-K students" had exposure to some other form of Pre-K (for example, Head Start) even though they did not attend TPS Pre-K.

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[12] Duncan, G.J., Dowsett, C., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., Pagani, L.S., Feinstein, L., Engel, M., Brooks-Gunn, J., Sexton, H., Duckworth, K., and Japel, C. (2007) . School Readiness and Later Achievement. *Developmental Psychology*, 1428–1446.

[13] Gormley, Jr., W. T. and Gayer, T. (2005). *Promoting School Readiness in Oklahoma: An Evaluation of Tulsa's Pre-K Program*. *The Journal of Human Resources*, XL, 533-558.

Lamy, Barnett, and Jung (2005) studied Pre-K programs in five states: including South Carolina, Michigan, New Jersey, Oklahoma, and West Virginia.[14] Using a regression discontinuity (RDD) design, the researchers assessed the impact of Pre-K intervention on students using state standardized tests that were administered to "same aged" students at the beginning of Pre-K and at the beginning of Kindergarten. Students were measured at the start of Pre-K or at the beginning of Kindergarten, providing the researchers a baseline measure as well as the ability to account for individual differences. School readiness measures were utilized to determine the impact of Pre-K, and included assessments of receptive vocabulary, print awareness, phonological awareness, and math (in each state except for South Carolina). The degree to which the groups differed varied from state to state (i.e., some states experienced a smaller Pre-K effect than others), but in each case, statistically significant results were found in support of a Pre-K effect, such that students in Kindergarten who attended Pre-K scored better on the school readiness measures in all areas (except for phonological awareness) than same-aged students in Pre-K.

A study of the Abbott preschool in New Jersey program examined the impact of New Jersey Pre-K for the highest poverty districts in the state.[15] This study employed a regression discontinuity design that utilized a cut-off point at Kindergarten entry. A longitudinal cross-sectional approach compared children who attended Pre-K with those who did not attend Pre-K as identified by an informant that had access to a student's school records and/or parent report. The researchers assessed aspects of the program (such as classroom quality) as well as educational outcomes in the form of receptive vocabulary, mathematics skills, and print awareness. The study found statistically significant improvements in children's outcomes upon Kindergarten entry as well as at the end of Kindergarten for all assessments except for print awareness at the end of Kindergarten, and that classroom quality improved over time as the program developed. Finally, they found that children who attended Pre-K for two years significantly outperformed those only attending for one year or not at all. However, long-term effects were not addressed in this study.

2. Potential Benefits for At-Risk Populations

The benefits of Pre-Kindergarten as an intervention to improve school readiness seems fairly clear, but more recently early childhood programs have been identified as a means of closing what some researchers consider to be the "achievement gap"—a persistent and recurring pattern of low academic achievement among economically disadvantaged students and racial and ethnic minority students—the very gaps the No Child Left Behind Act aims to close. Increasingly and at many levels, attention is turning to Pre-Kindergarten programs as a means of closing what some have called the "school readiness gap"—an early pattern of low academic performance and poor sociobehavioral skills observed among children entering Kindergarten and First Grade.[16] Some researchers have argued that achievement gaps in high school could potentially be closed by eliminating early gaps in Kindergarten or First Grade.[17]

One study that addresses the potential benefits of Pre-K participation for at-risk groups is an evaluation of Chicago's Child-Parent Center (CPC) preschool program. The CPC developed a same-age cohort of 1,539 minority children born in 1980; all participants were considered to be

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[14] Lamy, C, Barnett, W. S. Jung, K. (2005). *The Effects of the Michigan School Readiness Program on Young Children's Abilities at Kindergarten Entry*. The National Institute for Early Education Research.

[15] Frede, E, Jung, K, Barnett, W. S, Lamy, C., and Figueral, A. (2007). *The Abbott Preschool Program Longitudinal Effects Study*. Interim Report.

[16] Sadowski, M. (2006).

[17] Jencks, C. and Phillips, M. (Eds). (1998). *The Black-White Test Score Gap.* Washington, D.C.: Brookings Institution Press.

socioeconomically disadvantaged.[18] The study, published in 2001, examined longitudinal data from a program that matched children in the intervention (Pre-K) group with students who were eligible for the program but did not participate to form a comparison group. The comparison group was composed of children that were of a similar age, eligible for participation in government programs, and experiencing neighborhood/family poverty. The CPCs were located in various neighborhoods and provided Pre-K services as well as extended program support services throughout Grade Five. These services were available to all children/students in the service neighborhood (i.e., the services were available to students in the Pre-K group as well as those in the non-Pre-K group). Pre-K participation improved participating children's language skills; Hispanic and Black children who attended full-day showed the most pronounced effects of participation in the program. Further, customized outcome variables were studied in a 15-year follow-up study which included educational attainment by age 20, official juvenile arrests, and need for school remedial services. The study found that students who attended Pre-K had achieved higher levels of educational attainment, had fewer formal charges on average, and had fewer incidences of needing remedial services while in school.[19] Additionally, the study found that those students who were enrolled in the CPC Pre-K program took advantage of the extended program support for an average of 3.95 years while those students that did not enroll in Pre-K only received an average of 0.68 years between Kindergarten and Grade Five. Support services were provided to participants well beyond the Pre-K program through more advanced levels of the children's development, making its comparability to a short-term intervention like Pre-K questionable. This study does provide evidence that early intervention prior to school entry does offer potential benefits in particular to minority and other at-risk populations.

Ethnically diverse children in poverty may be particularly poised to benefit from a high-quality, school-based Pre-K program. In one recent study, children living in an impoverished urban environment who attended one year of preschool began their Pre-K year at significant risk, as indicated by a relatively low percentile rank (32nd to 43rd percentile) compared to national norms in language, cognition, and fine motor skills. After one year, however, children were re-tested and substantial gains were observed in all these areas such that children were performing at or around the national average (47th to 52nd percentile). The greatest gains were seen among low-income children attending public school-based Pre-K programs (compared with center-based community child care or Title I Pre-K programs), and in particular in the areas of language and cognition.[20] These data certainly suggest that much is to be gained from a year of exposure to early childhood education—particularly for urban, economically disadvantaged, ethnically- and linguistically diverse children.

Despite its promise, the ability of Pre-K as a strategic, broad-based means of closing achievement gaps, however, remains unclear. First, gaps up to one full standard deviation have been found in national measures between Black and White children and Hispanic and White children as early as age four. This leads at least some researchers to believe gaps may already exist even at the Pre-K level.[21] A recent study using data from the Early Childhood Longitudinal Study (ECLS) found that once children enter school, the gaps only increase from Kindergarten entry to First Grade for minority and economically disadvantaged students. Minor differences in Kindergarten due to gender, ethnicity, and

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[18] Reynolds, A.J. (1994). Effects of a Preschool Follow-On Intervention for Children at Risk. *Developmental Psychology, 30*, 787-804.

[19] Reynolds, A.J., Temple, J.A., Robertson, D.L., and Mann, E.A. (2001). Long-term Effects of An Early Childhood Intervention on Educational Achievement and Juvenile Arrest: A 15-year Follow-up of Low-Income Children in Public Schools. *Journal of the American Medical Association*, *285*, 2339-2346.

[20] Winter, A., Tran, H., Hartman, S., Madigan, A., Manfra, L., and Bleiker, C. (2008). School Readiness Gains Made by Ethnically Diverse Children in Poverty Attending Center-based Childcare and Public School Pre-Kindergarten Programs. *Early Childhood Research Quarterly, 23*, 314-329.

[21] Wang, A. (2008). A Pre-Kindergarten Achievement Gap? Scope and Implications. *US-China Education Review*, 23-31.

socioeconomic status seem to "increase and consolidate" by the time children reach First Grade.[22] When participation in Pre-K is taken into account, however, Pre-K participation is associated with higher reading and mathematics performance at school entry, and the estimated effects of Pre-K or preschool are slightly larger for economically disadvantaged children. By the end of First Grade, though, the cognitive effects "have largely dissipated," although the effects are slightly more likely to persist for disadvantaged children.[23] Past the point of school entry, classroom- and school-level characteristics should not be underestimated, and in fact national studies and Tennessee-specific investigations (e.g., Tennessee's STAR study) have found that environmental factors like teacher education and classroom size are strongly related to student achievement.[24]

In terms of access to Pre-K programs nationally, there is significant variation in program quality. Further, there are growing gaps in terms of access to high-quality programs. National research has found racial and ethnic differences both in enrollment in early childhood education programs as well as in the quality of services received in these programs. Specifically, Hispanic children are less likely than White children to be enrolled in preschool programs, but Black children are more likely than White children to be enrolled in preschool. In terms of the types of preschool programs attended, however, White children are more likely to be enrolled in high-quality preschool programs. This observed disparity in quality of preschool environment is largely driven by socioeconomic factors, as Black and Hispanic children are more likely to experience economic disadvantage than White children and are thus more likely to participate in publicly-funded programs of varying quality.[25] Thus, according to the research, exposure to preschool education in itself is not necessarily likely to close gaps in academic achievement that might emerge between these groups; both exposure to and quality of early childhood programs are relevant considerations.

Should one or two years of early childhood intervention be expected to permanently and totally reduce disparities in children's academic performance that evolve due to economic disadvantage? In a research briefing to the US House of Representatives Committee on Ways and Means, Dr. Jeanne Brooks-Gunn likened this reasoning to "magical thinking." After an intervention like Pre-K ends, children remain in the same neighborhoods, the same schools, and experience the same socioeconomic and environmental risk factors that accompany economic disadvantage like exposure to toxins and violence.[26] To see any results of Pre-K at all beyond its immediate impact in Kindergarten, Brooks-Gunn argues, is "impressive," despite the relatively small magnitude of the effects.

3. Few Long-Term Results

So, what has the research shown to be the long-term impact of Pre-K participation on student outcomes? No review of Pre-K efforts would be complete without mention of the North Carolina Abecedarian Project, a randomized study of four cohorts of children in North Carolina from 1972 to

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[22] Chatterji, M. (2006). Reading Achievement Gaps, Correlates, and Moderators of Early Reading Achievement: Evidence from the Early Childhood Longitudinal Study (ECLS) Kindergarten to First Grade Sample. *Journal of Educational Psychology*, 98, 489-507.

[23] Magnuson, K.A., Ruhm, C., and Waldfogel, J. (2007). Does Prekindergarten Improve School Preparation and Performance? *Economics of Education Review*, 26, 33-51.

[24] Finn, J. D., and Achilles, C. M. (1999). Tennessee's Class Size study: Findings, Implications, Misconceptions. *Educational Evaluation and Policy Analysis*, 21, 97-109.

[25] Magnuson, K A. and Waldfogel. J. (2005).

[26] Brooks-Gunn, J. (2003). Do you Believe in Magic? What We Can Expect from Early Childhood Intervention Programs. *SCRD Social Policy Report*, 17, 1-14.

1977.[27] This study followed a total of 111 economically disadvantaged children from infancy (some as young as six-weeks old) throughout their early adult lives, and found, through a series of interviews, tests and school records, that the children were impacted far beyond their Pre-K years. Abecedarian Project researchers worked individually with children in the intervention group for several years, administering numerous learning games and tests, all of which were designed to stimulate the children's cognitive and relational skills. The children were assessed using IQ tests and compared with regard to their performance in and outside of school. The study found those who received this early intervention maintained higher IQ scores than their peers into adulthood, achieved higher levels of education overall, received higher test scores, and benefited from various other positive life outcomes.[28] This study does suggest potential benefits of early childhood education, but was clearly an intensive and long-term intervention—not at all comparable to "typical" Pre-K programs in wider implementation today.

Another well-known randomized study addressing the impact of early childhood education is the High Scope/Perry Preschool Program in Ypsilanti, Michigan from 1962 to 1967.[29] This study examined 123 impoverished African-American children, who were divided into two groups: an intervention group that received Pre-K intervention for both age 3 and 4, and a group that did not receive the intervention. Much like the Abecedarian Project, these students were followed well into adulthood (even as recently as their 40th year in 2005). Several standardized and customized measures which analyzed outcomes such as social responsibility (i.e. delinquency, marital status and pregnancy), scholastic success (i.e. achievement test scores, GPA), and socioeconomic success (i.e. earnings, home ownership) were employed.[30] Findings showed both short-term and long-term effects of participation in the program, including increased IQ scores in Kindergarten and higher levels of academic achievement later on in school (at age 14). More recently, those who received the intervention were found to make more money (on average), graduate from high school in greater proportions, and have fewer formal arrests and charges. Still, like the Abcedarian Project, the length and scope of the intervention, as well the intensity of intervention and the term of program support was highly individualized and the results are not necessarily generalizable to other populations or programs. Also, at the time these studies were conducted (both prior to 1980), access to Pre-K was not widespread; indeed many important and transformational changes in education have taken place since these interventions were implemented. Although these studies are widely cited as evidence for a clear and causal effect of Pre-K, they are not without their limitations.

Another early longitudinal study of New York's state-wide experimental Pre-K program was begun in 1975.[31] A sample of 1,348 low-SES and special needs students were exposed to a preschool program that included: 1) in-school experience, 2) health services, 3) social services, and 4) parental involvement. The children in the sample were assessed at the end of Pre-K, the beginning of Kindergarten, the end of Kindergarten, and at the end of Grades 1, 2, and 3, thus creating a series of data intended to assess the impact of the Pre-K intervention. Various customized measures were used to assess cognitive development, non-cognitive/behavioral characteristics, and normal progress through primary grades. Favorable results of the program were found for the cognitive and non-cognitive development measures at the beginning of Kindergarten. Over the time period between the

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[27] Anderson, M. (2005). *Uncovering Gender Differences in the Effects of Early Intervention: A Reevaluation of the Abecedarian, Perry Preschool, and Early Training Projects*. MIT Department of Economics.

[28] The Abecedarian Project. http://www.fpg.unc.edu/~abc/#home

[29] The High/Scope Perry Preschool Study. http://www.highscope.org/Content.asp?ContentId=219

[30] Parks, G. *The High/Scope Perry Preschool Study*. http://www.ncjrs.gov/html/ojjdp/2000_10_1/contents.html

[31] Irvine, D. J., Horan, M. D., Flint, D. L., Kukuk, S. E., and Hick, T. L. (1982). Evidence Supporting Comprehensive Early Childhood Education for Disadvantaged Children. *Annals of the American Academy of Political and Social Science*, 461, 74-80.

beginning of Pre-K and the end of Second Grade, however, the students in the Pre-K group began to show fewer cognitive differences from the non-Pre-K children until, at the end of Second Grade, there were essentially no differences between the two groups. When considering normal progress through Third Grade (i.e., not being retained in any grade), a significant positive effect was found for those students who participated in Pre-K. The differences between Pre-K and non-Pre-K groups were less evident over time, leading the authors ultimately to express that "the prospect of maintaining the effects of Pre-K is unpromising." [32]

The US Department of Health and Human Services (HHS) issued a report in December 2003 that summarized the evidence of state-funded Pre-K programs to date. This report acknowledged that many states provided high-quality Pre-K programs, but had limitations that "constrained" definitive knowledge about their effects. The HHS study compiled information from the various state-funded programs in the areas of cognition, language, and academic achievement, and found multiple positive outcomes at the end of a student's state-funded Pre-K experience across the board. Each state study utilized its own methods and assessments, and the HHS report summarized the findings across the domains of cognition/language, behavior, health, attendance, grade retention, grades, special education referrals, and parent involvement. Nine states (Florida, Kentucky, New York, Georgia, Washington, Maryland, Michigan, South Carolina, Texas) and the District of Columbia found beneficial effects of Pre-K in some form. Four states consistently found beneficial effects of Pre-K when assessed at the end of Pre-K, and of the six states which assessed students during the Kindergarten year, three found consistently beneficial effects of Pre-K while the other three found mixed results among cohorts in the domains of cognition/language. Considering all states that were included in the report, mixed results were found in the domains of behavior, attendance, and grade retention. Those states that followed their Pre-K students beyond Kindergarten, however, saw fewer differences between their Pre-K and non-Pre-K students as time progressed in the domains of cognition and language. Altogether, few differences were observed between Pre-K and non-Pre-K students at the end of Kindergarten, even fewer differences were observed at the end of First Grade, and even fewer differences remained at the end of Second and Third Grades.[33]

School readiness—not simply participation in Pre-K—is more convincingly predictive of later academic achievement. In a recent study using data from six large-scale longitudinal studies (two of which were nationally representative), the impact of school readiness in three domains, socioemotional skills, school entry academic skills, and attention, was examined in terms of its ability to predict academic achievement using multiple indicators, including grade completion, math and reading achievement, teacher ratings, and test scores. Using rigorous statistical controls for prior child, family, and contextual influences, the researchers found across 6 studies the strongest predictors of later academic achievement were school-entry math skills, reading skills, and attention skills, with early math skills having the greatest predictive power for long-term achievement (up to age 14).[34] This study emphasizes the importance of students' developmental assets and capacity upon entering Kindergarten—not simply their exposure to a Pre-Kindergarten environment. Understandably, Pre-K students and their families will exhibit individual differences both in the way they use the services provided through the program as well as in their individual gains as a result of exposure to those services. As Pre-K students enter school, they will fall along a continuum of "readiness." In school, they will further fall along a continuum of learning. In evaluating the effectiveness of a program like Pre-K, it is important to take into consideration these individual differences with quantitative measures of both exposure as well as individual outcomes—something

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[32] Ibid. p. 78.

[33] U.S. Department of Health and Human Services. *State-Funded Pre-Kindergarten: What the Evidence Shows*. December 2003.

[34] Duncan, et al. (2007).

the present evaluation of Tennessee's Pre-K program is unable to do given limited records of program participation and dearth of data on individual student outcomes immediately post-Pre-K.

Summary

Taken together, what are the implications of the research reviewed here in terms of the present evaluation of Pre-K in Tennessee? First, taking the findings of many different approaches and methodologies into consideration, it is clear that Pre-K programs create an opportunity to stimulate growth and development at a critical period in child development. Children who respond to this intervention are then positioned to learn more quickly and to potentially carry this advantage further in their educational careers. Still, the literature is fairly clear that the limited nature of the intervention limits its impact, and the duration of this potential advantage remains unclear.

What is essential—and notably lacking from the present evaluation of Tennessee's Pre-K program—are "readiness" measures that capture individual differences in both exposure and response to Pre-K to provide a more realistic picture of children's "readiness" to succeed upon school entry. The present evaluation, retrospective in nature and using fairly blunt measures, provides an initial examination of these issues. Still, the findings of this evaluation to date are consistent with what has been found in both academic and applied research on the subject of Pre-K effectiveness across the country over the last 20 years.

The remainder of this report reviews the findings to date and provides the results of additional supplemental analyses conducted since the Second Interim Report.

Evaluating Tennessee's Pre-K Program: Summary of Findings to Date

Project Overview

The present evaluation, commissioned by the Tennessee Office of the Comptroller, aims to investigate the short- and long-term effects of Pre-Kindergarten participation on academic outcomes in Kindergarten through Fifth Grade. The evaluation is structured to take place over a three-year timeframe and in a series of reporting stages. Table 1, below, summarizes the years and cohorts studied in this report as well as the years of data analyzed in each report. The overarching goal of this effort is to identify Pre-K participants in existing school assessment records and to determine, to the best possible extent given the data available for analysis, whether there is evidence to suggest that Pre-K participation is associated with a positive effect on student performance in Grades K-5 relative to students who did not participate in Pre-K.

Table 1. Cohorts and Program Years Covered in this Evaluation and Corresponding Stages of Reporting

	1998-1999	**1999-2000**	**2000-2001**	**2001-2002**	**2002-2003**	**2003-2004**	**2004-2005**	**2005-2006**	**2006-2007**	**2007-2008**	**2008-2009**
Cohort 1	Pre-K	K	1st	2nd	3rd	4th	5th				
Cohort 2		Pre-K	K	1st	2nd	3rd	4th	5th			
Cohort 3			Pre-K	K	1st	2nd	3rd	4th	5th		
Cohort 4				Pre-K	K	1st	2nd	3rd	4th	5th	
Cohort 5					Pre-K	K	1st	2nd	3rd	4th	5th
Cohort 6						Pre-K	K	1st	2nd	3rd	4th
Cohort 7							Pre-K	K	1st	2nd	3rd
Cohort 8								Pre-K	K	1st	2nd
Cohort 9									Pre-K	K	1st
Cohort 10										Pre-K	K
Cohort 11											Pre-K
	Pilot Pre-K Program Only							**Pre-K Expansion and Curriculum Alignment (starting in 2005)**			
Reporting Stage		***First Interim Report***					***Second Interim Report***			***2008 Annual Report/ Third Interim Report***	***2009 Annual Report/ Final Report***

The State of Tennessee has been funding early childhood education since the 1990s. Legislation enacted in 1996 permitted the creation of Pilot early childhood and Pre-Kindergarten programs for economically disadvantaged three- and four-year-olds. In the 1998-1999 school year, 30 Pilot Pre-K classrooms were created, serving approximately 600 students. Since then the program has grown to over 934 classrooms, serving approximately 17,000 children. Table 2 summarizes the number of students served and the number of classrooms in operation in Tennessee since 1998-1999.

Table 2. Number of Students Enrolled in Tennessee Pre-K, 1998-1999 to 2007-2008

Program Year	Students Served	Number of Classrooms
1998-1999	600	30
1999-2000	600	30
2000-2001	3,000	150
2001-2002	3,000	90
2002-2003	3,000	150
2003-2004	2,900	150
2004-2005	2,900	147
2005-2006	8,900	446
2006-2007	13,000	677
2007-2008	17,308	934

Source: State of Tennessee, Office of Early Learning

Summary of Findings: The First Interim Report

The First Interim Report of this evaluation conducted for the State of Tennessee (November, 2007) analyzed student assessment data between 1999-2000 and 2003-2004. This included assessment data for the first five cohorts of Pre-K students who participated in Pre-K between 1998-1999 and 2002-2003. The goal of the analysis was to identify Pre-K participants based on their student records and to compare them to a matched sample of non-Pre-K students to determine whether Pre-K participation was associated with higher performance on assessments in later grades relative to a matched sample of students who did not participate in Tennessee's Voluntary Pre-K program. No measures of student outcomes prior to Kindergarten entry were available for analyses, nor were any measures of exposure to Pre-K (i.e., number of days attended, part-time vs. full-time attendance, etc.). Therefore, "Pre-K participation" is defined as having a valid student record in the Pre-K demographic file provide by the TDOE Office of Early Learning.[35]

Although this analysis covered a period of five years, it was complicated by the fact that data collection efforts were limited in the early, formative years of the Pre-K program. This resulted in some missing data for key variables (for example, gender, race) and some missing student identifiers, which made it impossible to merge some Pre-K participant data with student records in K-2. An additional issue faced by this evaluation was that administration of assessments in Grades K-2 is not mandatory in Tennessee. Administering K-2 assessments is a decision left up to the discretion of individual Local Education Agencies (LEAs). Thus even if a Pre-K student could be identified, very few (less than 10%) had valid assessments in Kindergarten—a particularly important time point in assessing the short-term impact of Pre-K participation, and the point in time at which the relative impact of Pre-K participation is most likely to be observed (see pages 8-16 of this report). Assessments themselves also differed, with norm-referenced assessments administered in Kindergarten-Second Grade and criterion-referenced assessments administered in Grades 3-5—making longitudinal comparisons of students across these two types of assessments difficult to interpret. Taken altogether, and given the number of children who participated in the early years of the Pre-K program, the data available for analysis were quite limited. However, every effort was made to use all available data and to conduct a reasonable analysis of student outcome data to address the primary research questions to the best possible extent.

[35] "Valid" records contained an encrypted social security number (ESSN), had no anomalies in the record that could not be resolved, and no differences in demographic information between data sources (Pre-K student information file, TDOE assessment record, or TDOE EIS record) that could not be resolved or confidently attributed to a data entry error.

Due to the small number of Pre-K participants for whom data were available across multiple years, longitudinal tests (i.e., analyses using data from the same students measured at multiple points in time) were not feasible for the time period between 1999-2004; grade levels were thus analyzed separately. However, rigorous sampling techniques were used to construct comparison groups of at-risk students who did not participate in Tennessee's Pre-K program. Specifically, the non-Pre-K samples were selected such that they mirrored the Pre-K groups with regard to school district, gender, race, and FRPL status. Analyses presented in the first interim report were limited only to students who received FRPL, given the focus of the Pre-K program and priority afforded to students meeting this definition of "risk." [36] This group, those who received FRPL at least once in the time period under study for this report, represented the majority of Pre-K participants.

The findings from this initial exploration of the data were mixed and inconclusive, but did suggest some possible positive correlates of Pre-K participation to be explored further. Across analyses of the first five cohorts of students over five years, there were some positive effects associated with Pre-K participation: Pre-K participants scored slightly higher on some assessments (primarily reading and language arts). However, statistically significant differences between Pre-K participants and students who did not attend Tennessee's Voluntary Pre-K program were relatively small in magnitude. The pattern of results generally seemed to change between cohorts, although it was a recurring pattern that Pre-K students scored slightly higher than the comparison group of at-risk students. These effects emerged in many assessments, including Reading, Language, Word Analysis, Spelling, Social Studies, and Science—although the effects were not consistent. The association between Pre-K participation and outcomes in mathematics, science, and social students was variable and suggested that if Pre-K participation is associated with positive effects in these domains, the aggregate effect seemed to be small and short-term in nature. Given the small number of students for whom data were available and the early, formative stage of the Pre-K program at the time these early cohorts of children participated, these results were encouraging but merited further exploration. A longitudinal analysis tracking students over time was a logical next step in the analysis, as the number of student participants in the program increased and the ability to identify Pre-K participants in assessment records was improved with more complete recent records.

For the Second Interim Report, covering program years 2004-2005, 2005-2006, and 2006-2007, substantially more student data were available. The Pre-K program had expanded in 2005, tripling the number of Pre-K classrooms statewide. Unfortunately, some limitations still remained in terms of conducting an evaluation using K-5 assessment data. First, a conceptual constraint was present in the form of curricular and programmatic changes in implementation of the Pre-K program. The Pre-K program has not been "static" since its inception in 1998, which makes evaluation of long-term program effects problematic. A fairly significant number of program changes took place in 2005, including the process of curricular alignment to state education standards. This means that program implementation prior to 2005 was different in meaningful ways from program implementation post-2005, and comparisons of outcomes for program participants pre- and post-2005 must take these changes into consideration.

Second, data limitations still remained despite higher numbers of program participants. Because a large number of LEAs did not conduct assessments in Grades K-2, data on the short-term effects for a great proportion of Pre-K participants were not available. Because the primary goal of Tennessee's Pre-K program is "Kindergarten readiness," the fact that Kindergarten assessment data were not available for approximately 90% of Pre-K participants remained a challenge (see Table 3).

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[36] *Assessing the Effectiveness of Tennessee's Pre-Kindergarten Program: First Interim Report* (November, 2007).

Table 3. Estimated Percentage of All Tennessee Students Assessed in Grades K-2 between 2004-2005 and 2006-2007

	Grade K	Grade 1	Grade 2
2004-2005	10%	42%	80%
2005-2006	9%	38%	77%
2006-2007	6%	35%	62%

Given that data were available for so few students in Kindergarten and First Grade in particular, we were concerned that any differences in outcomes that may actually exist between Pre-K and non-Pre-K students would be difficult to detect, or alternatively that the results may not be reliable due to the characteristics of the schools conducting assessments in Grades K-2. Both of these issues have been explored further and are addressed later in this report.

Summary of Findings: The Second Interim Report

The Second Interim Report drew from three data sources: 1) Pre-Kindergarten demographic data, 2) K-12 student assessment data, and 3) Education Information System (EIS) student data from the 2005-2006 and 2006-2007 school years. Pre-K students were identified in assessment records and individually matched to another student with the same demographic characteristics in the same school and/or district who did not attend Pre-K.[37] This rigorous precision matching technique was employed to construct a sample of non-Pre-K students that matched the Pre-K group as closely as possible given the data available for analysis.

The analytic approach taken in the Second Interim Report differed from the approach taken in the First Interim Report. A larger number of students had participated in Pre-K in the timeframe under study and there was an opportunity for longitudinal analysis. Data were analyzed using random effects models, also referred to as hierarchical linear models or multilevel models, and the goal of these analyses was to attempt to determine whether Pre-K participation was associated with higher outcomes on assessments in Grades K-5 relative to the sample of non-Pre-K participants.

For assessments administered in Kindergarten, Pre-K students scored better, in the aggregate, than a matched sample of non-Pre-K students. Thus, for Reading, Language Arts, and Mathematics, students who participated in Pre-K tended to score significantly higher, on average, on their end-of-year Kindergarten assessments relative to peers who did not attend Tennessee's Pre-K. However, students' socioeconomic status, as indicated by receipt of FRPL, also had a significant effect, such that students who did not receive FRPL (and were thus not considered to be "at risk" due to economic disadvantage) scored higher on average than students who did receive FRPL.

The pattern observed in Kindergarten, however, changed in First and Second Grades. The growth curve models which identified an initial difference in Kindergarten assessment scores between Pre-K and non-Pre-K students showed a pattern of convergence over time. In other words, although Pre-K students initially demonstrated an advantage on these assessments over peers who did not participate in Pre-K, by the Second Grade there was virtually no difference in the average assessment

[37] In fact, Pre-K students were matched with up to four non-Pre-K students depending on the size of the Pre-K group each grade and year, and the number of available non-Pre-K students with the exact set of characteristics required. For more detail, see the Second Interim Report, page 22.

scores attributable to Pre-K participation. Analysis of student outcomes in Grades 3-5 estimated no reliable effects associated with Pre-K participation, in the aggregate.

Updated Analyses of Student Outcome Data for 2004-2007

Additional analyses have been conducted since the Second Interim Report. In an effort to include as many students as possible in the analysis, data files were re-examined, and it was discovered that a large number of Pre-K cases which had been excluded from previous analyses due to missing or incomplete data could be cleaned and captured for inclusion in the models. A second difference was that out-of-grade-level test scores were identified and removed from the analysis. Including extra valid cases and removing the few out-of-grade-level test scores increased substantially the power and validity of the statistical tests, but changed only slightly the pattern of results observed and reported in the Second Interim Report. Ultimately, final growth curve models used a sample size of 15,138 students in Kindergarten-Second Grade and 13,115 students in Third-Fifth Grade; difference score models used a sample size of 12,914 students; and single time point models used a sample size of 9,730 students. Because of the large sample size involved in this analysis, a more conservative level of significance was deemed appropriate and is reported ($p < 0.01$). Sample sizes, means (model-implied scores), *p*-values, and effect sizes for all comparisons are reported in Appendix A.

As found previously, on end-of-year assessments administered in Kindergarten, Pre-K students scored better, in the aggregate, than a matched sample of non-Pre-K students in Reading and Mathematics (see Table 4). Thus, for these three assessments, students who participated in Pre-K tended to score significantly higher, on average, on their end-of-year Kindergarten assessments relative to peers who did not attend Tennessee's Pre-K program. The overall difference for Language Arts was not significant using the more rigorous criterion of $p < 0.01$, but the effect size is similar of that observed in previous analyses ($d = 0.04$, $p < 0.02$). With the inclusion of additional student records in these updated analyses, however, the effect of Pre-K was found to be limited to students considered "at risk" due to low socioeconomic status (i.e., students who received FRPL). Still, the magnitude of these effects is small—an estimated relative difference of between 4-7 points on these assessments. Effect sizes (Cohen's *d*) are less than 0.1, with the largest effect size estimated for the comparison between Pre-K/Non-Pre-K students who had received FRPL on Kindergarten Mathematics ($d = 0.065$). For comparison, an effect size of $d = 0.2$ is considered a "small" effect by Cohen's guidelines.[38] However, in analysis of educational data, effect sizes are often likely to be small and so Cohen's guidelines for interpreting effect sizes may not necessarily apply; some caution is necessary in terms of interpretation of the effect sizes alone.[39] Despite these differences observed for economically disadvantaged students, the differences between Pre-K and non-Pre-K students who did *not* receive FRPL in Reading, Language Arts, or Mathematics were *not* statistically significant in these analyses. Table 4 presents estimated means for Kindergarten assessments.[40]

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[38] Cohen, J. (1988). *Statistical Power for the Behavioral Sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

[39] Valentine, J. C. and Cooper, H. (2003). *Effect Size Substantive Interpretation Guidelines: Issues in the Interpretation of Effect Sizes*. Washington, DC: What Works Clearinghouse. http://ies.ed.gov/ncee/wwc/references/iDocViewer/Doc.aspx?docId=1&tocId=1

[40] As noted in previous reports, all models presented here control for child race and gender. In addition, the models also include additional control variables: whether or not a child received special education within the observed grades, whether or not a child was retained within the observed grades, the average number of days a child was absent from class during the observed timeframe, and whether or not the child's primary or native language is English. These control variables (and their theoretically or statistically relevant interactions) were included to ensure an accurate representation of the population under study and to ensure potentially mitigating effects were accounted for in the model to control for any potential bias.

Table 4. Model-Implied Adjusted Mean Scores for Pre-K and Non-Pre-K Students—Kindergarten (Revised)

	Group					
Assessment	**Pre-K**	**Non-Pre-K**	**Pre-K FRPL**	**Non-Pre-K FRPL**	**Pre-K No FRPL**	**Non-Pre-K No FRPL**
Kindergarten Reading	**559.55***	**556.06***	**555.19****	**550.52****	563.90	561.60
Kindergarten Language Arts	561.21	557.28	**556.01****	**550.21****	566.40	564.35
Kindergarten Mathematics	**520.88***	**514.79***	**513.98****	**506.19****	527.78	523.39

Note: Growth curve models based on a minimum sample size of 15,138 children.

* Denotes a statistically significant difference between Pre-K and non-Pre-K students, at the $p < 0.01$ level after adjusting for multiple comparisons (means appear in bold).

** Denotes a statistically significant difference between Pre-K and non-Pre-K students who received FRPL, at the $p < 0.01$ level after adjusting for multiple comparisons (means appear in bold).

*** Denotes a statistically significant difference between Pre-K and non-Pre-K students who did not receive FRPL, at the $p < 0.01$ level after adjusting for multiple comparisons (means appear in bold).

The lack of an apparent significant difference among the students who did not receive FRPL may still represent an advantage of Pre-K participation. If program slots remain unfilled after economically disadvantaged students are enrolled, priority is given to students who are "at risk" by other definitions—including children who are in state custody or who are at risk due to abuse or neglect, regardless of income. After the first 20 days of the new school year, the LEA can request to enroll all other children if spots remain unfilled.[41] Thus, at least some portion of this group of Pre-K students has some identifiable (although not necessarily economic) risk factors. Students in the non-FRPL comparison group, on the other hand, have no identified disadvantage (economic or otherwise). Therefore, among non-FRPL students, the fact that the Pre-K group (for whom some form of risk is more likely) is performing at least as well as the Non-Pre-K group in Kindergarten could be construed as evidence of a potential benefit associated with Pre-K.

Overall, growth curve models using three time points (Kindergarten, First, and Second Grades) showed the same general pattern of convergence at the Second Grade as observed in previous analyses, and overall differences between the Pre-K and non-Pre-K groups were not statistically significant at the $p < 0.01$ level (see Table 5). However, with increased statistical power, slight but statistically significant differences emerged in Second Grade for economically disadvantaged students (i.e., students who had received FRPL) in Language and Mathematics, suggesting that for these assessments, a small but identifiable advantage associated with Pre-K participation may persist through Second Grade. The relative difference between the Pre-K and Non-Pre-K group (FRPL students only) was apparently diminished, however; effect sizes are smaller than those observed in Kindergarten ($d = 0.04$), with an estimated difference of approximately two points in Second Grade.

[41] Source: Tennessee Department of Early Learning, http://www.tennessee.gov/education/earlylearning/doc/OEL_FAQs.pdf, downloaded from the Internet in March 2009.

Among students who did not receive FRPL, students who attended Pre-K slightly underperformed Non-Pre-K students who did not attend Pre-K. Again, bearing in mind that although not economically disadvantaged, Pre-K students are more likely to experience other risk factors of multiple types, this difference may reflect the impact of these unmeasured risks on the Pre-K group.

Figures 1-3 show the overall pattern of results for the expanded analysis of Reading, Language Arts, and Mathematics in Kindergarten through Second Grade.

Table 5. Model-Implied Adjusted Mean Scores for Pre-K and Non-Pre-K Students—Second Grade (Revised)

	Group					
Assessment	**Pre-K**	**Non-Pre-K**	**Pre-K FRPL**	**Non-Pre-K FRPL**	**Pre-K No FRPL**	**Non-Pre-K No FRPL**
Second Grade Reading	616.42	618.35	611.47	611.22	**621.37*** **	**625.47*** **
Second Grade Language Arts	624.66	625.01	**619.51** **	**617.32** **	629.82	632.70
Second Grade Mathematics	569.86	570.23	**565.53** **	**563.46** **	574.19	577.00

Note: Growth curve models are based on a minimum sample size of 15,138 children.

Denotes a statistically significant difference between Pre-K and non-Pre-K students, at the $p < 0.01$ level after adjusting for multiple comparisons (means appear in bold).

** Denotes a statistically significant difference between Pre-K and non-Pre-K students who received FRPL, at the $p < 0.01$ level after adjusting for multiple comparisons (means appear in bold).

*** Denotes a statistically significant difference between Pre-K and non-Pre-K students who did not receive FRPL, at the $p < 0.01$ level after adjusting for multiple comparisons (means appear in bold).

Figure 1. Model-Implied Adjusted Mean Scores for Reading in Grades K-2 for Pre-K and Non-Pre-K Students by Student FRPL Status

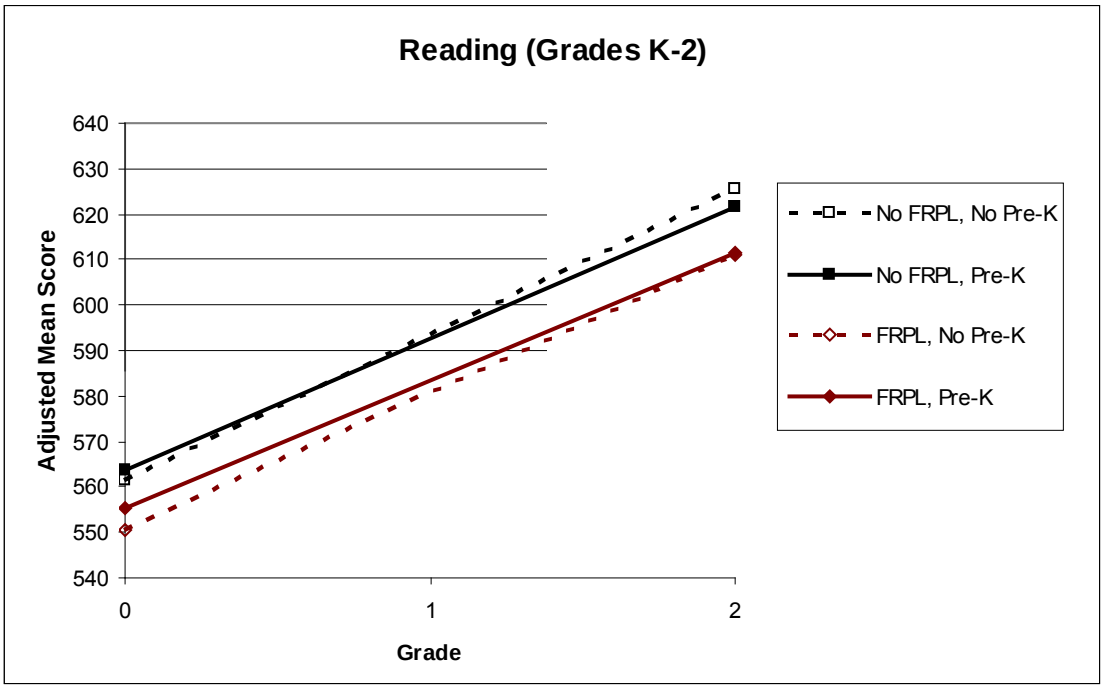


Figure 2. Model-Implied Adjusted Mean Scores for Language Arts in Grades K-2 for Pre-K and Non-Pre-K Students by Student FRPL Status

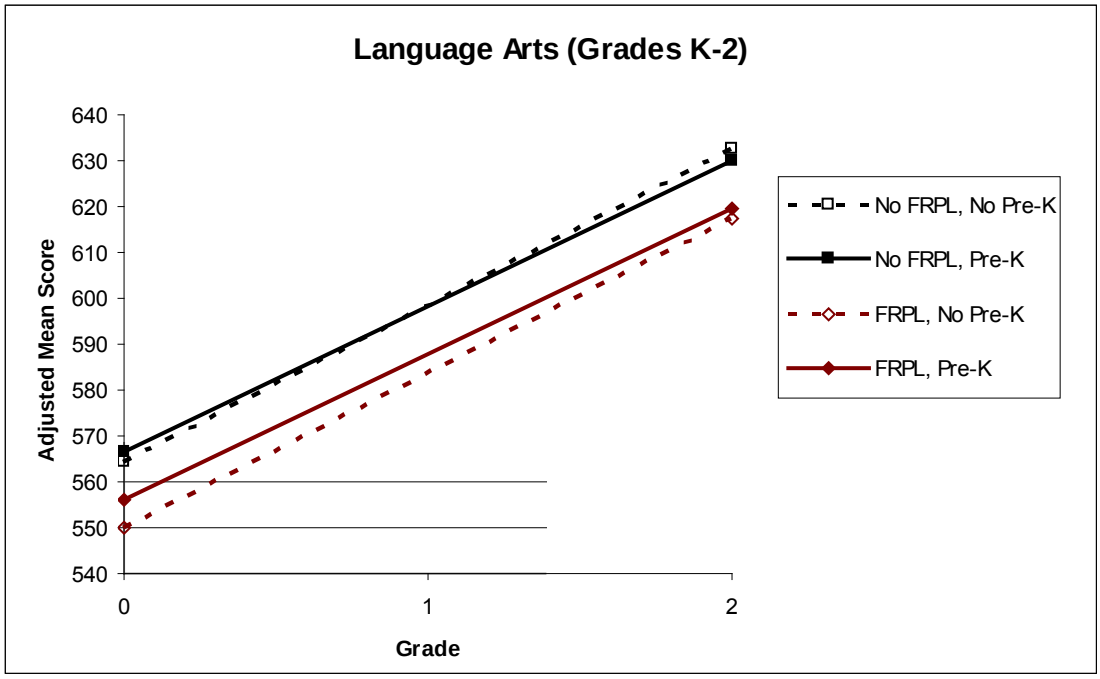
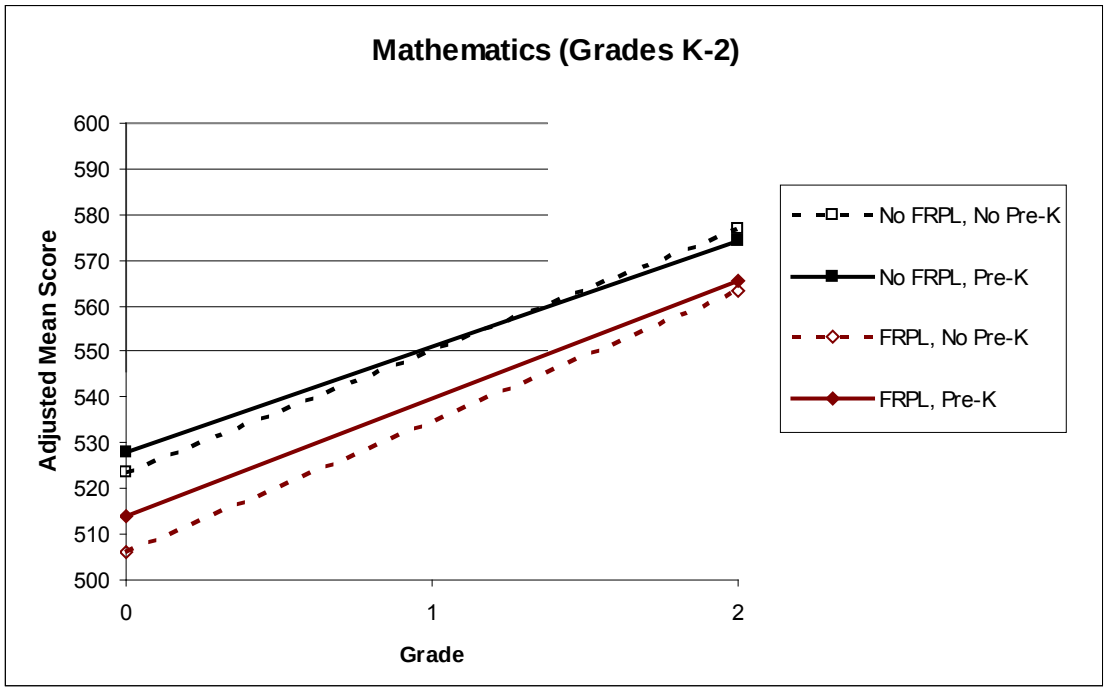


Figure 3. Model-Implied Adjusted Mean Scores for Mathematics in Grades K-2 for Pre-K and Non-Pre-K Students by Student FRPL Status



In addition to Reading, Language Arts, and Mathematics, students in the First Grade also complete Norm-Referenced Assessments in Vocabulary, Word Analysis, Math Computation, Social Studies, and Science. Because these assessments are administered in both the First Grade and the Second Grade, it was again possible to examine student performance over two years in these areas using difference score modeling with the increased sample. Spelling is assessed only in Second Grade and so single time point models are used to compare Pre-K and Non-Pre-K students on that assessment.

Consistent with previous analyses conducted for this annual report, Pre-K participation was not in itself a significant predictor of student performance on assessments in First or Second Grades, and none of the aggregated Pre-K/Non-Pre-K comparisons indicated a significant effect of Pre-K. Among students who received FRPL, however, there were several small but statistically significant effects associated with Pre-K participation that appear to persist into First and Second Grades. In First Grade, Pre-K students who received FRPL had, on average, higher scores for Word Analysis, Math Computation, Science, and Social Studies than Non-Pre-K students who also received FRPL. The effects were small (estimated between 2-4 points, $d < 0.1$) and limited only to students who received FRPL (that is, students who experienced economic disadvantage). Pre-K effects for these assessments were also found in Second Grade, again showing Pre-K students who received FRPL scoring slightly higher, in the aggregate, than Non-Pre-K students who received FRPL. The effect sizes for these differences were smaller than those observed in First Grade, or for the previously discussed Kindergarten effects.

The single time point model for the Spelling assessment also found a significant effect for Pre-K, again among students who received FRPL. Model-implied estimates are provided in Table 6.

Table 6. Model-Implied Adjusted Mean Scores for Pre-K and Non-Pre-K Students at First and Last Observation (First and Second Grades—Revised)

	Group					
Assessment	**Pre-K**	**Non-Pre-K**	**Pre-K FRPL**	**Non-Pre-K FRPL**	**Pre-K No FRPL**	**Non-Pre-K No FRPL**
First Grade Vocabulary	564.64	563.7	558.37	555.86	570.91	571.54
First Grade Word Analysis	592.46	590.4	**588.34****	**583.52****	596.58	597.28
First Grade Math Computation	502.86	501.21	**500.01****	**496.19****	505.70	506.23
First Grade Social Studies	593.99	591.25	**588.82****	**585.15****	599.16	597.35
First Grade Science	573.14	570.24	**567.51****	**563.28****	578.76	577.19
Second Grade Vocabulary	598.94	599.895	593.48	592.00	604.40	607.79
Second Grade Word Analysis	622.77	622.20	617.67	615.69	627.86	628.70
Second Grade Math Computation	547.67	546.82	**542.11****	**539.41****	552.22	554.22
Second Grade Social Studies	610.87	612.84	**605.28****	**602.77****	**616.45*****	**622.91*****
Second Grade Science	589.61	589.59	**584.30****	**581.10****	594.91	598.08
Second Grade Spelling	586.26	587.26	**580.30****	**576.52****	594.22	596.00

Note: Difference score models based on a minimum sample size of 12,914 children; single time point models based on a minimum sample size of 9,730 children.

* Denotes a statistically significant difference between Pre-K and non-Pre-K students, at the $p < 0.01$ level after adjusting for multiple comparisons (means appear in bold).

** Denotes a statistically significant difference between Pre-K and non-Pre-K students who received FRPL, at the $p < 0.01$ level after adjusting for multiple comparisons (means appear in bold).

*** Denotes a statistically significant difference between Pre-K and non-Pre-K students who did not receive FRPL, at the $p < 0.01$ level after adjusting for multiple comparisons (means appear in bold).

Among students who did not receive FRPL, there was one statistically significant difference for Social Studies. The First Grade effect suggests a relative advantage for Pre-K participants, but the effect does not persist into Second Grade, and in fact appears to reverse. This is neither consistent with the

overall pattern of results found in other analyses in this report nor in other evaluations of Pre-K programs. This effect is likely due to increased variability in students' outcomes in higher grades that is not reasonably attributable to Pre-K participation, and, as discussed previously, this may also reflect the fact that Pre-K students who did not receive FRPL likely have other risk factors that have not been captured or measured, and therefore cannot be controlled for in the present analyses. Figures 4-8 show the trends for these assessments in First and Second Grades.

Figure 4. Model-Implied Adjusted Mean Scores for Vocabulary in Grades 1-2 For Pre-K and Non-Pre-K Students by Student FRPL Status—Revised

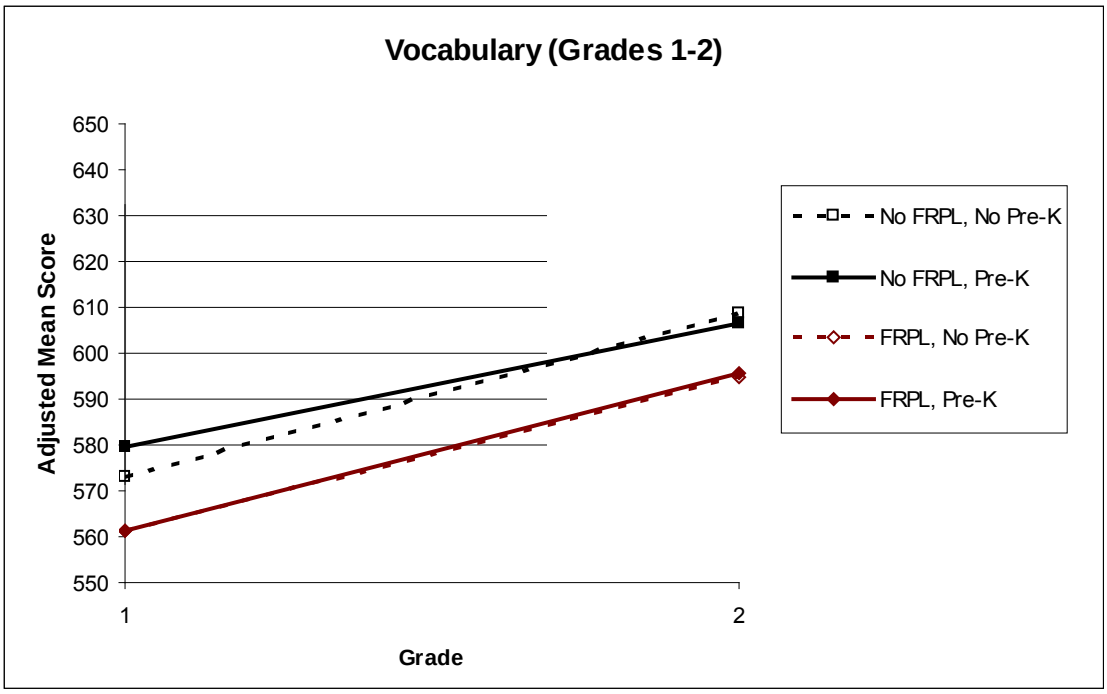


Figure 5. Model-Implied Adjusted Mean Scores for Word Analysis in Grades 1-2 for Pre-K and Non-Pre-K Students by Student FRPL Status—Revised

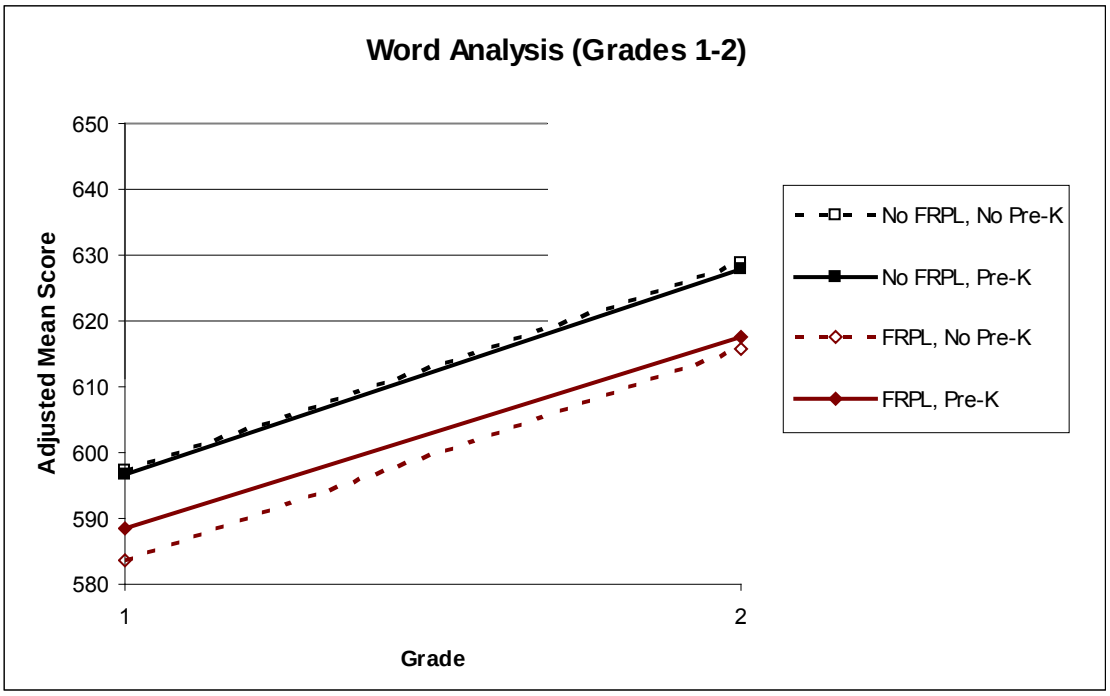


Figure 6. Model-Implied Adjusted Mean Scores for Math Computation in Grades 1-2 for Pre-K and Non-Pre-K Students by Student FRPL Status—Revised

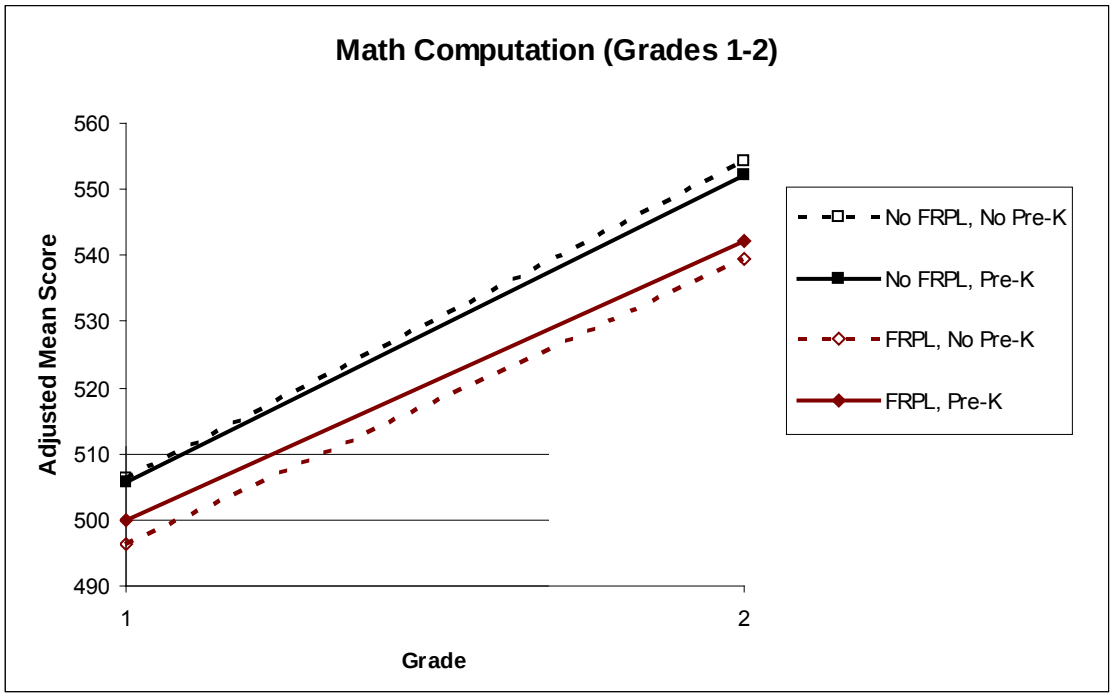


Figure 7. Model-Implied Adjusted Mean Scores for Social Studies in Grades 1-2 for Pre-K and Non-Pre-K Students by Student FRPL Status—Revised

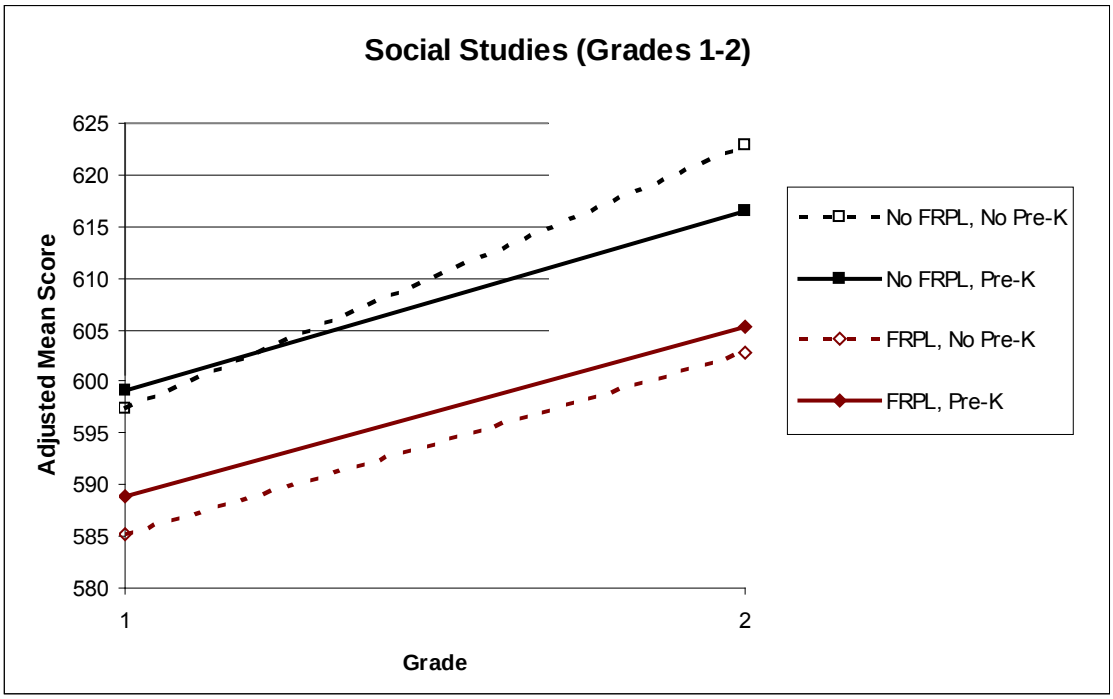
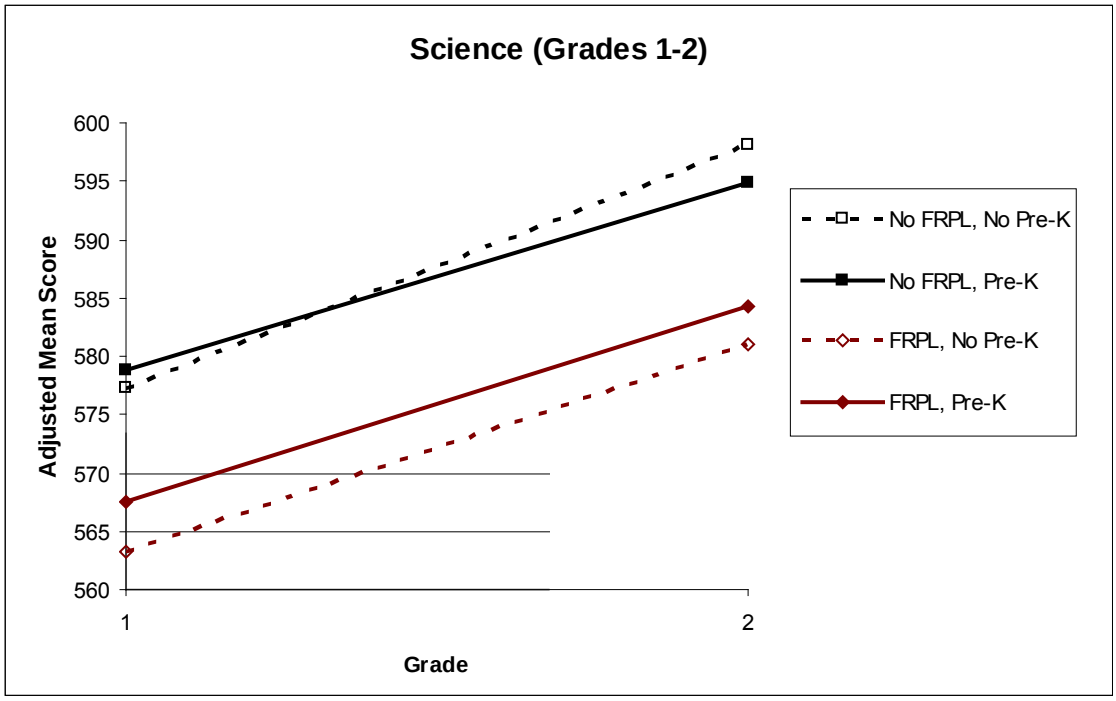


Figure 8. Model-Implied Adjusted Mean Scores for Science in Grades 1-2 for Pre-K and Non-Pre-K Students by Student FRPL Status—Revised



Long-term Effects of Pre-K Participation

In Grades 3-5, Criterion-Referenced Assessments are administered in Reading, Mathematics, Social Studies, and Science. Student performance on these assessments is compared to a predetermined standard (i.e., “cut point”) to determine proficiency. The cut points established by TDOE for each of these subjects in each grade are presented in Table 7.

Table 7. TCAP Cut Scores for Reading, Mathematics, Social Studies and Science in Grades 3-5

Final Cut Scores Established in 2004			
Content Area	**Grade**	**Proficient**	**Advanced**
Reading	3	455	496
	4	461	510
	5	467	522
Mathematics	3	448	484
	4	457	507
	5	463	517
Social Studies	3	188	212
	4	190	216
	5	194	217
Science	3	188	213
	4	189	215
	5	191	218

Source: Tennessee Department of Education

In analyses across assessments administered in Grades 3-5, growth curve models showed no meaningful or systematic significant differences associated with Pre-K participation in Grades 3-5 (see Table 8). Pre-K participation was not a significant predictor for any assessment in Third Grade or Fifth Grade. The difference between students who received FRPL and those who did not (i.e., student socioeconomic status), was consistently a significant predictor for student outcomes across all assessments in Grades 3-5, although Pre-K participation was not a significant predictor overall for any assessments in Grades 3-5.

Some differences were observed among Pre-K and non-Pre-K students who did not receive FRPL (i.e., students who were not identified as economically disadvantaged). These differences likely reflect increased variability among the non-FRPL group as well as the impact of other risk factors apart from economic disadvantage (which are more prevalent among Pre-K students in Tennessee, given program eligibility requirements).

Table 8. Model-Implied Adjusted Mean Scores for Pre-K and Non-Pre-K Students at First and Last Observation (Grades 3-5—Revised)

	Group					
Assessment	**Pre-K**	**Non-Pre-K**	**Pre-K FRPL**	**Non-Pre-K FRPL**	**Pre-K No FRPL**	**Non-Pre-K No FRPL**
Third Grade Reading	485.76	486.96	482.46	481.59	**489.06*** **	**492.32*** **
Third Grade Mathematics	476.10	477.03	473.41	472.22	**478.78*** **	**481.84*** **
Third Grade Social Studies	201.04	201.34	197.99	197.44	204.09	205.24
Third Grade Science	202.33	202.89	200.15	199.50	**204.50*** **	**206.27*** **
Fifth Grade Reading	505.35	505.46	505.35	505.46	**515.23*** **	**519.98*** **
Fifth Grade Mathematics	512.09	512.79	508.14	506.82	516.04	518.76
Fifth Grade Social Studies	202.96	202.85	202.96	202.85	**207.02*** **	**210.29*** **
Fifth Grade Science	205.59	205.78	202.52	202.17	208.65	209.38

Note: Models based on a minimum sample size of 15,138 children.

* Denotes a statistically significant difference between Pre-K and non-Pre-K students, at the $p < 0.01$ level after adjusting for multiple comparisons (means appear in bold).

** Denotes a statistically significant difference between Pre-K and non-Pre-K students who received FRPL, at the $p < 0.01$ level after adjusting for multiple comparisons (means appear in bold).

*** Denotes a statistically significant difference between Pre-K and non-Pre-K students who did not receive FRPL, at the $p < 0.01$ level after adjusting for multiple comparisons (means appear in bold).

Summary of Findings to Date

On the whole, the results of the additional analyses conducted since the Second Interim Report again point to an initial advantage associated with Pre-K participation in Kindergarten—primarily for students who received FRPL or are considered “at-risk” due to socioeconomic status. In analyses of assessments administered in First and Second Grades, this initial difference is followed by a pattern of convergence, although a slight advantage of Pre-K participation appears to be maintained among economically disadvantaged students. Pre-K participation, despite being associated with significant differences in early assessments of Reading, Language Arts, and Mathematics, is not a significant predictor for student outcomes in Grades 3-5.

The models employed using the data available to date suggest that this relative advantage is slight, limited to economically disadvantaged students, and does not persist past the Second Grade. As students in the present study moved through higher grades, their scores tended to converge so that students receiving FRPL tended to be more similar to one another (irrespective of their participation in Pre-K) and students who did not receive FRPL tended to be more similar to one another (again, irrespective of Pre-K participation). As additional years of program data become available and our opportunity to conduct longitudinal analysis increases, this question will continue to be addressed in more detail.

Follow-up and Exploratory Analyses

Investigating the Potential for Bias due to Matching Procedures

Several of the findings from the Second Interim Report merited additional analysis and exploration of the available data. Of particular concern is the question as to whether the matching procedure used in the Second Interim Report to construct the comparison group could potentially be masking the effects of Pre-K. Equivalence is always a concern when constructing a comparison group, and matching is always limited to observable characteristics—that is, characteristics that have been defined and measured in specific ways. In the present evaluation the set of observed characteristics for which data are available is limited to student gender, race/ethnicity, FRPL status, grade level, and school. All of these variables were utilized to construct the comparison group. Students were drawn for the comparison group from assessment records, and this creates a potential source of bias for comparisons at higher grade levels because of the large amounts of missing data in K-2 assessments. For example, a Pre-K student who attended a school that administered assessments in Kindergarten would be matched with another Kindergarten student who did not participate in Tennessee's Voluntary Pre-K program, who resembled the Pre-K student's demographic characteristics as closely as possible, and who also had assessment records in Kindergarten. A Pre-K student who attended a school that did not administer assessments until Second Grade would then not appear in the assessment records until that point, and would then be matched to a Second Grade student who did not participate in Pre-K but who otherwise resembled the Pre-K student's demographic characteristics as closely as possible at that point.

Because complete EIS data are not available for academic years prior to 2005-2006, construction of the non-Pre-K comparison group for cohorts who attended Pre-K between 1998-99 and 2004-05 relied completely upon the availability of assessment data. This becomes a potential problem in particular in the case of Pre-K students who attended schools that did not administer assessments in Kindergarten and/or First Grade, because matched cases were not drawn for them until they first appeared in assessment records. The problem is that much less is known about comparison group students who were drawn from assessment records in First, Second, or even Third Grade, and as a result there is more variability implicit in the comparison group—particularly when matching takes place at higher grade levels. Thus, a very relevant question to be addressed is whether the apparently diminishing effect of Pre-K participation at higher grades is a "real" effect or whether it is simply a result of greater variability in the comparison group masking a genuine benefit of Pre-K participation over the long term.

To attempt to address this question, we conducted an additional exploratory analysis on student data from 2004-2005, 2005-2006, and 2006-2007 and limited it only to students who could be matched in Kindergarten—that is, students who were matched at the earliest possible point given the data available—and conducted a longitudinal analysis. Although this drastically limits the number of cases included in the analyses (N = 2,802 for growth curve models, N = 1,094 for difference score models, and N = 529 for single-time-point models) it eliminates the possibility that the matching procedure at higher grades "dilutes" a real effect of Pre-K participation beyond Kindergarten. Grade levels and years included in this analysis are summarized in Table 9.

Table 9. Grade Levels and Years Included in Analysis when Sample is Restricted to Students Matched in Kindergarten

2004-2005	2005-2006	2006-2007
K	1st	2nd
	K	1st
		K

Once again, data were analyzed using random effects models, also referred to as hierarchical linear models or multilevel models. Growth curve models using three time points examined performance of the Pre-K and non-Pre-K group in assessments for Reading, Language Arts, and Mathematics from Kindergarten through Second Grade. Difference score modeling was used to analyze assessment data for Vocabulary, Word Analysis, Math Computation, Social Studies, and Science (administered in First and Second Grades). Spelling, administered only in Second Grade, was examined using a single time point model. Thus, this analysis replicates the analytic approach taken for the full dataset but limits the sample to only those students matched in Kindergarten in 2004-2005, 2005-2006, or 2006-2007. Given the reduced sample size, a standard significance level of $p < 0.05$ was used. All means, p-values, and effect sizes are reported in Appendix A.

The pattern of results observed in this analysis (Tables 10 and 11) did not reveal any hidden effects of Pre-K participation but followed the same trends observed in the overall sample. Specifically, a significant effect associated with Pre-K participation was observed in Kindergarten for Mathematics but were not observed for any assessments in First or Second Grades. Although the analyses discussed earlier conducted with the full sample found a significant overall effect of Pre-K participation for Reading and Language Arts as well as Mathematics in Kindergarten, that effect was not found in this restricted sample. It is quite possible this is due to a reduction in sample size and the corresponding reduction in statistical power.

However, for this reduced sample and within the group of students who received FRPL, Pre-K students scored slightly but significantly higher on average than non-Pre-K students. Pre-K participation was a significant predictor of performance on the Mathematics and Reading assessments, but once again the benefit was limited to students who received FRPL. There were no other significant differences associated with Pre-K participation in First or Second Grades.

Table 10. Model-Implied Adjusted Mean Scores for Pre-K and Non-Pre-K Students at First and Last Observation (Kindergarten and Second Grade)—Students Matched in Kindergarten Only

	Group					
Assessment	**Pre-K**	**Non-Pre-K**	**Pre-K FRPL**	**Non-Pre-K FRPL**	**Pre-K No FRPL**	**Non-Pre-K No FRPL**
Kindergarten Reading	551.84	549.69	**546.94****	**543.35****	556.73	556.02
Kindergarten Language Arts	552.33	550.55	547.16	543.92	557.50	557.18
Kindergarten Mathematics	**519.11***	**512.89***	**510.41****	**504.71****	527.81	521.07
Second Grade Reading	623.38	623.19	618.81	618.65	627.94	627.73
Second Grade Language Arts	629.85	626.51	623.87	622.45	635.83	630.57
Second Grade Mathematics	573.12	572.6	569.34	568.47	576.90	576.73

Note: Growth curve models are based on a minimum sample size of 2,802 children; difference score models are based on a minimum sample size of 1,094 children, and single-time-point models are based on a minimum sample size of 529 children.

* Denotes a statistically significant difference between Pre-K and non-Pre-K students, at the $p < 0.05$ level after adjusting for multiple comparisons (means appear in bold).

** Denotes a statistically significant difference between Pre-K and non-Pre-K students who received FRPL, at the $p < 0.05$ level after adjusting for multiple comparisons (means appear in bold).

*** Denotes a statistically significant difference between Pre-K and non-Pre-K students who did not receive FRPL, at the $p < 0.05$ level after adjusting for multiple comparisons (means appear in bold).

Table 11. Model-Implied Adjusted Mean Scores for Pre-K and Non-Pre-K Students at First and Last Observation (First and Second Grades)—Students Matched in Kindergarten Only

	Group					
Assessment	**Pre-K**	**Non-Pre-K**	**Pre-K FRPL**	**Non-Pre-K FRPL**	**Pre-K No FRPL**	**Non-Pre-K No FRPL**
First Grade Vocabulary	563.17	562.85	560.16	559.28	566.18	566.42
First Grade Word Analysis	592.22	590.07	587.05	585.67	597.39	594.46
First Grade Math Computation	501.80	501.40	494.50	495.24	509.09	507.55
First Grade Social Studies	599.19	594.64	592.94	588.04	605.43	601.23
First Grade Science	580.83	575.38	574.09	569.46	587.57	581.29
Second Grade Vocabulary	599.19	602.59	593.70	595.15	604.67	610.02
Second Grade Word Analysis	622.98	620.68	620.16	618.89	625.80	622.47
Second Grade Math Computation	559.54	552.34	554.80	545.12	564.27	559.55
Second Grade Social Studies	624.95	616.80	621.96	615.25	627.93	618.34
Second Grade Science	600.13	597.40	595.27	597.13	604.98	597.67
Second Grade Spelling	575.94	577.80	578.78	569.85	573.10	585.74

Note: Difference score models based on a minimum sample size of 1,094 children; single-time-point models are based on a minimum sample size of 529 children.

* Denotes a statistically significant difference between Pre-K and non-Pre-K students, at the $p < 0.05$ level after adjusting for multiple comparisons (means appear in bold).

** Denotes a statistically significant difference between Pre-K and non-Pre-K students who received FRPL, at the $p < 0.05$ level after adjusting for multiple comparisons (means appear in bold).

*** Denotes a statistically significant difference between Pre-K and non-Pre-K students who did not receive FRPL, at the $p < 0.05$ level after adjusting for multiple comparisons (means appear in bold).

Investigating the Potential for Bias Due to Incomplete Records

The previous analysis suggests that the attenuation of the effects associated with Pre-K participation is not solely a result of sampling techniques. Still, this analysis includes students who may have incomplete records—that is, students may have been matched in Kindergarten but did not complete First and Second Grade assessments, or students who have Kindergarten and First Grade assessment data but not Second Grade data. As an additional exploratory analysis, we limited the sample to students who had completed three years of assessments (thus, they completed Kindergarten in 2004-2005). This again substantially reduced the sample size (N = 516) but provides a very straightforward examination of student progress over the course of three consecutive years.

Limiting the sample in this way was initially expected to make the effects of Pre-K participation more evident because the sample was restricted to students who had been matched in Kindergarten and had complete assessment records for Kindergarten, First, and Second Grades. However, contrary to expectations, the results revealed even fewer positive effects associated with Pre-K in Kindergarten and once again no significant effects in First or Second Grades in any of the assessments (see Table 12). There were no statistically significant effects associated with Pre-K participation in Reading or Language Arts in Kindergarten. However, there was an overall effect of Mathematics such that Pre-K participation was associated with a higher average score on end-of-year Kindergarten assessments. This pattern held primarily for students who did *not* receive FRPL. Among students who received FRPL, there was a trend for Pre-K students to score higher in mathematics than non-Pre-K students, although this difference did not reach conventional levels of statistical significance it could be considered “marginally significant” ($p = 0.08$).

Table 12. Model-Implied Adjusted Mean Scores for Pre-K and Non-Pre-K Students at First and Last Observation (Kindergarten and Second Grade)—Students with Complete Assessments Only

	Group					
Assessment	**Pre-K**	**Non-Pre-K**	**Pre-K FRPL**	**Non-Pre-K FRPL**	**Pre-K No FRPL**	**Non-Pre-K No FRPL**
Kindergarten Reading	556.9	555.94	551.95	550.25	561.85	561.63
Kindergarten Language Arts	559.82	557.32	555.91	551.18	563.72	563.45
Kindergarten Mathematics	**516.75***	**509.12***	516.75	509.12	**539.99*****	**520.55*****
Second Grade Reading	623.14	623.73	619.23	619.26	627.04	628.19
Second Grade Language Arts	631.51	628.71	623.87	624.54	639.14	632.88
Second Grade Mathematics	577.77	574.51	573.10	569.99	582.44	579.03

Note: Models based on a minimum sample size of 516 children.

* Denotes a statistically significant difference between Pre-K and non-Pre-K students, at the $p < 0.05$ level after adjusting for multiple comparisons (means appear in bold).

** Denotes a statistically significant difference between Pre-K and non-Pre-K students who received FRPL, at the $p < 0.05$ level after adjusting for multiple comparisons (means appear in bold).

*** Denotes a statistically significant difference between Pre-K and non-Pre-K students who did not receive FRPL, at the $p < 0.05$ level after adjusting for multiple comparisons (means appear in bold).

Examination of assessments completed in First and Second Grades (Word Analysis, Vocabulary, Math Computation, Science, and Social Studies) revealed no effects associated with Pre-K participation (see Table 13).

The reader should keep in mind that limiting the analysis only to students matched in Kindergarten reduces the sample by roughly 97%, and correspondingly limits the statistical power of the analyses. Further, although it is worthwhile to examine the results for this subset of children, this analysis introduces yet another potential form of bias, as it excludes entirely the roughly 90% of LEAs that did not administer assessments in Kindergarten in 2004-2005.

Table 13. Model-Implied Adjusted Mean Scores for Pre-K and Non-Pre-K Students at First and Last Observation (First and Second Grades)—Students with Complete Assessments Only

	Group					
Assessment	**Pre-K**	**Non-Pre-K**	**Pre-K FRPL**	**Non-Pre-K FRPL**	**Pre-K No FRPL**	**Non-Pre-K No FRPL**
First Grade Vocabulary	567.58	565.40	569.16	562.66	565.99	568.13
First Grade Word Analysis	593.41	595.24	589.50	589.25	597.32	601.23
First Grade Math Computation	502.61	504.38	499.11	498.11	506.11	510.65
First Grade Social Studies	601.41	595.17	595.94	589.41	606.88	600.93
First Grade Science	583.49	576.36	576.47	571.23	590.52	581.48
Second Grade Vocabulary	601.65	605.14	598.55	597.37	604.75	612.9
Second Grade Word Analysis	623.175	623.55	621.20	620.97	625.15	626.13
Second Grade Math Computation	560.19	555.18	557.26	547.50	563.11	562.86
Second Grade Social Studies	625.11	617.59	622.03	616.23	628.18	618.95
Second Grade Science	600.81	598.53	595.78	598.33	605.84	598.73
Second Grade Spelling	578.24	580.32	580.21	572.24	576.26	588.39

Note: Difference score models based on a minimum sample size of 1,094 children; single-time-point models are based on a minimum sample size of 529 children.

* Denotes a statistically significant difference between Pre-K and non-Pre-K students, at the $p < 0.01$ level after adjusting for multiple comparisons (means appear in bold).

** Denotes a statistically significant difference between Pre-K and non-Pre-K students who received FRPL, at the $p < 0.01$ level after adjusting for multiple comparisons (means appear in bold).

*** Denotes a statistically significant difference between Pre-K and non-Pre-K students who did not receive FRPL, at the $p < 0.01$ level after adjusting for multiple comparisons (means appear in bold).

Impact of Pre-K Curricular Alignment in 2005-2006

A final exploratory analysis involves the impact of Pre-K curricular revisions and alignment to state academic standards for Kindergarten in the 2005-2006 program year. More specifically, in Pre-K program year 2005-2006, not only did the program expand in terms of the number of students served, but the program model changed in terms of improving its alignment to Kindergarten standards. Therefore, a relevant question to be addressed is whether students who participated in Pre-K in 2005-2006 performed better in Kindergarten relative to students who participated in Pre-K prior to the curricular alignment.

Data available to address this question are limited, given that only one year of Kindergarten data are available in the years under study in the present report. However, the one year of program data relevant to this question were examined in an attempt to identify any relative advantage in Kindergarten outcomes associated with curricular alignment.

Students participating in the Pre-K program prior to alignment (2004-2005) would have been expected to enter Kindergarten in 2005-2006. Students participating in Pre-K in 2005-2006, the first year the program was aligned to state standards for Kindergarten, would have been expected to enter Kindergarten in 2006-2007. Therefore, comparison of Kindergarten assessments between 2005-2006 and 2006-2007 may yield some indication of a relative advantage of Pre-K participation in the program due to curricular alignment.

Table 14 summarizes the results for the three Kindergarten assessments over two years, 2005-2006 (reflecting Pre-K participation pre-alignment to standards) and 2006-2007 (reflecting Pre-K participation post alignment to standards). The results were limited to Pre-K students only to determine whether students who participated in the aligned Pre-K program performed better on Kindergarten assessments relative to Pre-K students who participated in the program prior to alignment. Means were compared using independent-samples t-tests, and no statistically significant differences were found (all p's > 0.50). Given the broad scope of the changes involved in this curricular alignment and the fact that 2005-2006 was only the first year of alignment, it may realistically take longer for the impact of the curricular revision to be apparent; future analyses will take the program differences pre- and post-2005 into consideration.

Table 14. Outcomes on Kindergarten Assessments Before and After Program Curricular Alignment to State Standards

Assessment	Year	N	Mean	Std Dev
Kindergarten Mathematics	2005-2006	175	510.8	46.8
	2006-2007	592	513.3	50.3
Kindergarten Reading	2005-2006	174	546.6	29.8
	2006-2007	593	547.5	37.6
Kindergarten Language	2005-2006	175	545.2	47.5
	2006-2007	593	548.0	49.4

Summary of Exploratory Analyses

Additional exploratory analyses were conducted to assess the potential for bias in the general analyses due to the matching procedure used to construct the comparison group as well as the potential for bias due to incomplete or missing assessments in Kindergarten through Second Grade. Limiting the samples only to students matched in Kindergarten and limiting the samples only to students with complete assessment records in Kindergarten-Second Grade, the effects of Pre-K participation were diminished but consistent with previous analyses. The largest and most reliable effects of Pre-K participation are found in Kindergarten. This suggests that the Pre-K program is meeting its objectives in terms of effective preparation for formal schooling or increasing "school readiness," but that the unique effects of Pre-K on academic achievement appear to diminish over time, as observed in other national and state-specific studies of Pre-K programs.

Characteristics of School Systems Attended by Pre-K Students

A relevant question in exploring the research objectives for this evaluation is what are the characteristics of school systems attended by Pre-K students? Further, given that only a small percentage of school systems administer assessments in Kindergarten – Second Grade, what are the characteristics of these school systems, and what are the implications for the results of this evaluation?

Table 15 summarizes the number of students participating in the Voluntary Pre-K program each academic year by LEA. These data were provided by the Office of Early Learning in the Pre-K demographic file, the primary record of program participation prior to the 2006-2007 academic year, when Pre-K participation began to be recorded in the EIS system. It is important to note that the figures in Table 15 represent "valid cases only," or student records that were complete and included a valid student identifier, as some records were incomplete and could not be used for analysis. As such, the actual numbers of Pre-K students who attended the program in a given year are larger in some instances than those reported in Table 15. Cells with a "$*$" denote instances in which the Pre-K demographic file did include records for that particular school system and school year, but because the records did not include a student identifier, the exact number of Pre-K students could not be determined.

The Pre-K program experienced continuous growth statewide between 1998-1999 and 2005-2006, with the largest increases occurring in the 2000-2001 and 2001-2002 school years, and especially in the 2005-2006 school year (as would be expected). There are 13 school systems with valid Pre-K records in every school year from 1998-1999 to 2005-2006. Conversely, there are 26 school systems with no valid Pre-K records for any of the eight years.

Table 15. Number of Students Participating in Pre-K by School System, 1998-1999 to 2005-2006

	Number of Pre-K Students by School System and Year (Valid Records Only)								
School System	**98-99**	**99-00**	**00-01**	**01-02**	**02-03**	**03-04**	**04-05**	**05-06**	**TOTAL 1998-2006**
Alamo								42	**42**
Alcoa								19	**19**
Alvin C York Institute									**0**
Anderson County	17	19	18	29	35	33	38	105	**294**
Athens								59	**59**
Bedford County									**0**
Bells								33	**33**
Benton County									**0**

Cont'd	Number of Pre-K Students by School System and Year (Valid Records Only)								
School System	**98-99**	**99-00**	**00-01**	**01-02**	**02-03**	**03-04**	**04-05**	**05-06**	**TOTAL 1998-2006**
Bledsoe County				17	14	11	17	38	**97**
Blount County	17	7	78	72	110	47	65	81	**477**
Bradford			1	14	16	14	14	35	**94**
Bradley County				36				62	**98**
Bristol			9	18		18	22	26	**93**
Campbell County				19	23	16	15	62	**135**
Cannon County								27	**27**
Carroll County									**0**
Carter County					33	*			**33**
Cheatham County								38	**38**
Chester County									**0**
Claiborne County	16	10	10	21	26	24	26	83	**216**
Clay County								34	**34**
Cleveland			33		34	53	44	119	**283**
Clinton								18	**18**
Cocke County									**0**
Coffee County	13	14	25	27	32	36	35	54	**236**
Crockett County									**0**
Cumberland County								105	**105**
Davidson County	9	4	59	218	243	183	175	383	**1274**
Dayton								12	**12**
Decatur County									**0**
DeKalb County			6	25	34	34	30	59	**188**
Dickson County			11	10	22	15	19	40	**117**
Dyer County	15	17	34	47	57	56	56	134	**416**
Dyersburg				10	19	20	20	44	**113**
Elizabethton			42	36		42	42	57	**219**
Etowah									**0**
Fayette County				22	49	63	62	110	**306**
Fayetteville								19	**19**
Fentress County								46	**46**
Franklin								15	**15**
Franklin County	15	19	36	62	84	70	63	136	**485**
Gibson County Special School District			5	37	32	35	36	55	**200**
Giles County									**0**
Grainger County								36	**36**
Greene County			16					99	**115**
Greeneville	3	2	20	63	76	83	87	109	**443**
Grundy County								14	**14**
Hamblen County								55	**55**
Hamilton County			48	92	99	97	107	320	**763**
Hancock County			14	12	23	17	24	60	**150**
Hardeman County								24	**24**
Hardin County								27	**27**
Hawkins County			5	12	16	9	17	35	**94**
Haywood County	28	21		27	27	30	30	32	**195**
Henderson County									**0**

Cont'd	Number of Pre-K Students by School System and Year (Valid Records Only)								
School System	**98-99**	**99-00**	**00-01**	**01-02**	**02-03**	**03-04**	**04-05**	**05-06**	**TOTAL 1998-2006**
Henry County	17		19	28	28	31	26	56	**205**
Hickman County								32	**32**
Hollow Rock Bruceton								20	**20**
Houston County								40	**40**
Humboldt			38	36	25	40	41	58	**238**
Humphreys County			5	3	17	19	16	77	**137**
Huntingdon								46	**46**
Jackson County			3	7	13	9	10	22	**64**
Jefferson County	12	10	12	6	30	67	23	100	**260**
Johnson City	12	11	13		40	25	27	36	**164**
Johnson County				27				29	**56**
Kingsport	16	16	28	31		21	30	65	**207**
Knox County	13	34	48	60	20	58	47	169	**449**
Lake County			*	15	38	20	20	34	**127**
Lauderdale County			19	*	11	22	18	86	**156**
Lawrence County	9	17	55	90	114	107	110	158	**660**
Lebanon								53	**53**
Lenoir City	17	30	15	35	51	36	33	36	**253**
Lewis County								41	**41**
Lexington								16	**16**
Lincoln County			19	26	25	20	20	36	**146**
Loudon County			15	19	35	22	20	92	**203**
Macon County									**0**
Madison County			20	53	65	91	94	152	**475**
Manchester								38	**38**
Marion County								57	**57**
Marshall County									**0**
Maryville								18	**18**
Maury County			6	78	87	59	64	65	**359**
McKenzie								19	**19**
McMinn County				14	13	15	9	50	**101**
McNairy County			15	20	21	15	21	81	**173**
Meigs County								43	**43**
Memphis	53	17	98	234	53	218	198	675	**1546**
Milan	4	17		35	41	40	49	60	**246**
Monroe County								22	**22**
Montgomery County								41	**41**
Moore County									**0**
Morgan County								70	**70**
Murfreesboro				49		64	80	151	**344**
Newport									**0**
Oak Ridge								38	**38**
Obion County								20	**20**
Oneida								34	**34**

Cont'd	Number of Pre-K Students by School System and Year (Valid Records Only)								
School System	**98-99**	**99-00**	**00-01**	**01-02**	**02-03**	**03-04**	**04-05**	**05-06**	**TOTAL 1998-2006**
Overton County								60	**60**
Paris									**0**
Perry County			10	6	17	12	10	34	**89**
Pickett County								14	**14**
Polk County								34	**34**
Putnam County			16	45	90	89	66	247	**553**
Rhea County			11	23	20	22	19	54	**149**
Richard City									**0**
Roane County									**0**
Robertson County								38	**38**
Rogersville								14	**14**
Rutherford County			29		61	*		72	**162**
Scott County				42	49	43	52	123	**309**
Sequatchie County			13	14	16	10			**53**
Sevier County	14	8	14	3	20	*	20	94	**173**
Shelby County			2	72	272	21	18	95	**480**
Smith County								30	**30**
South Carroll			14	21	20	17	19	23	**114**
Stewart County			4	7	16	20	6	49	**102**
Sullivan County			10	28	95	38	21	63	**255**
Sumner County									**0**
Sweetwater								23	**23**
Tennessee School for Blind									**0**
Tennessee School for Deaf									**0**
Tipton County								159	**159**
Trenton				9	20	20	15	35	**99**
Trousdale County									**0**
Tullahoma									**0**
Unicoi County			13	28	30	33	30	80	**214**
Union City								21	**21**
Union County								20	**20**
Van Buren County			22	16	15	22	21	22	**118**
Warren County								37	**37**
Washington County									**0**
Wayne County			18	41	44	47	46	84	**280**
Weakley County	18		18	48	15	5	2	32	**138**
West Carroll Special School District								20	**20**
West Tennessee School for Deaf									**0**
White County								21	**21**
Williamson County								104	**104**
Wilson County									**0**
TOTAL	**318**	**273**	**1,092**	**2,195**	**2,631**	**2,404**	**2,345**	**7,599**	***18,857***

The program expansion in 2005 resulted in a significant increase in the number of student participants in Pre-K in 2005-2006, and a much more broad representation of students across all school systems. However, this does not imply that students who attended Pre-K in a particular school system were then assessed in that school system, particularly in Grades K-2. Assessment records were provided in a separate file from the TDOE Office of Assessment, Evaluation and Research. These records were then matched to demographic data for Pre-K students provided by the Office of Early Learning.

As discussed earlier, only a small percentage of students who participated in Pre-K were assessed in Grades K-2. Table 16 summarizes the number of Pre-K students for whom assessment records are available in Grades K-5 by LEA, which illustrates the trend. Again, it is important to keep in mind that the actual numbers of students who attended Pre-K and then were administered assessments at any time in Grades K-5 will be greater in some instances than the numbers reported in Table 16. Table 16 includes only those students with both valid Pre-K and assessment records. If, for example, a student's social security number was not included the Pre-K demographic file and/or the assessment data, that student's Pre-K and assessment information could not be linked, and the student would not be included in Table 16.

Table 16. Number of Pre-K Students Assessed in Grades K-5, 2004-2007

System	Number of Pre-K Students Assessed by School System and Year																	
	2004-2005						2005-2006						2006-2007					
	K	1	2	3	4	5	K	1	2	3	4	5	K	1	2	3	4	5
Alamo	0	0	1	0	0	0	1	1	0	2	0	0	38	0	0	0	2	0
Alcoa	2	4	1	1	0	0	3	1	5	0	0	0	0	2	1	6	0	0
Alvin C York Institute	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anderson County	0	0	18	7	8	8	0	0	0	19	9	7	0	0	0	24	20	8
Athens	0	1	0	0	0	0	0	2	2	0	0	0	0	1	1	3	0	0
Bedford County	3	4	4	2	0	0	1	3	3	4	3	0	0	0	0	5	3	2
Bells	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	1	0	1
Benton County	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0
Bledsoe County	14	8	13	0	0	0	0	13	9	13	1	0	0	0	11	9	13	0
Blount County	0	0	59	37	4	7	0	0	57	57	39	5	0	0	69	56	56	37
Bradford	0	0	12	1	2	0	0	0	10	7	1	2	0	0	12	8	9	1
Bradley County	0	0	21	4	1	0	0	0	28	20	5	1	0	0	21	25	20	4
Bristol	0	19	19	1	0	0	0	23	16	16	1	0	0	22	21	20	17	1
Campbell County	0	23	14	0	0	1	0	11	18	14	0	0	0	11	11	18	12	0
Cannon County	0	2	1	1	0	0	1	1	2	0	1	0	22	3	1	2	1	1
Carroll County	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carter County	7	15	10	4	1	2	12	6	14	10	4	2	0	11	9	13	10	4
Cheatham County	0	1	2	0	0	1	0	0	2	2	0	0	0	1	0	2	2	0
Chester County	4	1	2	0	0	0	1	2	2	2	0	0	0	3	0	2	1	1
Claiborne County	0	0	13	8	6	4	0	0	18	15	10	7	0	0	14	22	18	8
Clay County	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cleveland	0	15	9	11	0	0	0	15	12	7	11	0	0	14	14	10	8	10
Clinton	0	6	2	4	1	0	0	7	6	2	4	1	0	8	6	5	2	5
Cocke County	0	0	0	1	0	0	0	0	1	2	1	0	0	0	0	1	2	1
Coffee County	0	0	0	14	11	5	0	0	0	15	15	11	0	0	0	23	15	16
Crockett County	0	1	4	0	0	0	0	1	2	3	0	0	0	2	0	2	4	1
Cumberland County	0	4	2	0	1	0	0	1	3	2	0	0	0	0	1	4	2	0
Davidson County	0	0	186	17	7	5	0	0	209	164	18	7	0	0	0	206	169	21
Dayton	0	1	1	0	0	0	0	1	0	1	0	0	0	1	1	1	3	0

Cont'd System	Number of Pre-K Students Assessed by School System and Year																	
	2004-2005						2005-2006						2006-2007					
	K	1	2	3	4	5	K	1	2	3	4	5	K	1	2	3	4	5
Decatur County	0	1	0	0	0	0	0	1	1	0	0	0	0	0	1	2	0	0
DeKalb County	0	23	18	3	0	0	0	30	24	19	3	0	0	14	26	24	14	4
Dickson County	0	0	15	3	0	0	0	0	13	11	2	0	0	0	21	11	14	2
Dyer County	0	48	27	6	0	1	0	42	46	27	6	0	0	48	37	44	29	6
Dyersburg	0	27	22	16	5	3	0	0	0	22	16	5	0	0	0	26	18	14
Elizabethton	0	0	23	21	0	0	0	0	26	24	21	0	0	0	29	26	22	22
Etowah	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Fayette County	0	47	11	0	0	0	0	47	41	11	0	0	68	48	46	41	10	0
Fayetteville	0	4	9	2	0	0	0	6	3	10	2	0	0	3	4	3	7	4
Fentress County	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Franklin	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Franklin County	0	0	49	25	14	7	0	0	61	46	25	14	0	0	67	66	46	26
Gibson County Special	0	32	24	4	0	0	0	28	29	23	3	0	0	31	26	28	25	4
Giles County	2	4	2	0	2	0	4	2	6	3	0	0	1	4	2	5	3	0
Grainger County	0	1	0	0	1	0	1	1	1	1	0	0	31	1	0	4	0	0
Greene County	0	0	0	7	2	1	0	0	0	28	10	2	0	0	0	34	31	9
Greeneville	0	0	15	4	3	0	0	0	21	12	2	4	0	0	26	22	14	1
Grundy County	0	0	1	1	0	0	0	0	0	0	1	0	14	0	0	0	0	1
Hamblen County	0	0	0	2	1	0	0	0	4	1	2	1	0	0	4	6	0	3
Hamilton County	20	30	89	28	2	1	21	51	74	84	26	3	0	62	80	77	84	26
Hancock County	19	21	7	5	0	0	18	21	17	7	5	0	39	16	20	17	7	3
Hardeman County	2	0	1	0	0	1	4	1	0	1	0	0	0	0	0	1	1	0
Hardin County	0	0	1	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0
Hawkins County	0	11	9	2	1	0	0	12	12	9	4	1	0	13	10	13	10	5
Haywood County	0	24	10	10	22	7	0	44	18	13	8	21	0	30	42	17	12	8
Henderson County	0	2	5	1	0	0	1	0	2	4	1	0	0	0	0	4	3	1
Henry County	10	17	14	5	8	1	14	10	17	11	5	8	35	13	12	17	10	6
Hickman County	3	2	2	1	0	0	4	1	4	3	1	0	30	3	1	6	4	0
Hollow Rock Bruceton	0	0	1	0	0	0	0	1	0	1	0	0	0	0	1	0	1	0
Houston County	0	1	2	0	0	0	0	0	0	1	0	0	0	1	0	0	2	0
Humboldt	0	21	24	12	0	0	0	29	12	24	12	0	0	35	32	14	24	9
Humphreys County	0	8	10	0	0	0	0	15	6	9	0	0	0	0	14	7	9	0
Huntingdon	2	1	2	5	0	0	1	2	3	2	5	0	34	1	2	3	2	5
Jackson County	0	7	7	1	0	0	0	10	6	4	1	0	0	11	7	7	6	0
Jefferson County	0	0	0	9	7	3	0	0	0	10	10	8	0	0	0	12	12	8
Johnson City	0	0	0	2	5	7	0	0	0	13	2	6	0	0	0	21	13	2
Johnson County	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Kingsport	0	0	5	19	9	8	0	0	0	16	19	9	0	0	0	26	16	16
Knox County	0	0	0	42	32	13	0	0	0	63	42	32	0	0	0	41	69	40
Lake County	27	26	8	1	1	0	17	24	26	8	1	1	24	15	20	27	8	1
Lauderdale County	0	0	0	1	1	0	0	0	0	8	4	1	0	0	0	14	7	4
Lawrence County	0	0	0	35	12	7	0	0	0	63	34	13	0	0	0	89	64	34

Cont'd System	Number of Pre-K Students Assessed by School System and Year																	
	2004-2005						2005-2006						2006-2007					
	K	1	2	3	4	5	K	1	2	3	4	5	K	1	2	3	4	5
Lebanon	0	0	0	1	0	1	0	0	0	2	1	0	0	0	0	1	1	1
Lenoir City	0	0	0	4	22	6	0	0	0	23	4	21	0	0	0	27	23	4
Lewis County	1	5	3	0	0	0	0	2	6	4	0	0	39	3	2	4	2	0
Lexington	0	1	2	0	0	0	1	0	2	3	0	0	16	0	0	1	2	0
Lincoln County	0	0	0	12	0	0	0	0	0	15	10	0	0	0	0	17	17	10
Loudon County	0	16	19	11	1	6	0	12	41	22	12	2	0	6	35	40	23	14
Macon County	0	1	0	0	1	0	0	0	1	0	1	1	0	0	0	1	0	0
Madison County	0	69	38	10	2	1	0	100	72	37	11	2	0	84	99	71	39	10
Manchester	0	0	0	3	0	0	0	0	0	3	3	0	0	0	0	2	2	1
Marion County	3	4	4	0	0	0	1	2	2	4	0	0	47	1	2	2	4	0
Marshall County	0	2	1	1	0	0	0	0	3	1	1	0	0	2	0	4	2	1
Maryville	0	2	3	4	1	0	0	1	5	4	3	0	0	2	2	7	4	3
Maury County	0	1	8	2	0	0	0	0	15	53	3	0	0	0	0	63	54	3
McKenzie	1	1	0	0	0	0	1	2	2	0	0	0	17	2	2	2	0	0
McMinn County	0	8	10	2	0	0	0	15	9	8	2	0	0	10	15	7	7	1
McNairy County	0	23	13	8	0	0	0	12	22	13	10	0	0	0	0	21	14	9
Meigs County	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	3	1	0
Memphis	2	102	183	63	47	22	0	139	258	175	59	42	0	91	249	264	168	63
Milan	42	34	24	5	9	2	36	45	33	27	4	10	53	35	43	33	28	5
Monroe County	0	0	1	0	0	0	0	0	1	1	0	0	0	0	2	3	1	0
Montgomery County	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	5	6	0
Moore County	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0
Morgan County	0	0	1	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0
Murfreesboro	0	31	33	8	1	0	0	52	31	32	6	1	0	53	54	28	27	6
Newport	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	1	0	0
Oak Ridge	0	0	3	1	0	2	0	0	1	3	1	0	0	0	2	1	2	1
Obion County	0	7	8	1	0	0	1	7	4	7	0	0	18	1	7	3	9	0
Oneida	0	0	3	0	0	0	0	0	6	2	0	0	0	0	0	8	4	0
Overton County	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	4	2	0
Paris	0	0	0	3	2	1	0	0	0	9	4	2	0	0	0	12	8	3
Perry County	12	15	5	1	0	0	10	13	10	5	1	0	0	0	15	11	7	1
Pickett County	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0
Polk County	0	0	2	0	0	0	0	0	2	2	0	0	0	0	1	2	2	0
Putnam County	0	0	0	5	0	0	0	0	0	29	5	0	0	10	18	56	27	5
Rhea County	0	0	14	3	0	0	0	0	19	14	5	0	0	0	0	18	11	5
Richard City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Roane County	0	0	4	2	0	0	0	0	4	4	2	1	0	0	0	3	4	2
Robertson County	0	2	1	0	0	0	0	3	2	2	0	0	0	1	2	2	3	1
Rogersville	0	0	3	0	0	0	0	0	4	3	0	0	0	0	3	4	3	0
Rutherford County	0	11	9	6	2	0	0	19	15	11	5	3	0	21	24	20	16	7
Scott County	0	44	19	0	0	0	0	36	40	21	0	0	0	41	32	40	20	0
Sequatchie County	4	16	18	4	0	0	5	4	13	16	5	0	0	4	4	15	17	5

Cont'd System	Number of Pre-K Students Assessed by School System and Year																	
	2004-2005						2005-2006						2006-2007					
	K	1	2	3	4	5	K	1	2	3	4	5	K	1	2	3	4	5
Sevier County	0	22	15	12	8	5	0	13	23	15	12	7	0	20	13	19	16	10
Shelby County	0	0	0	10	7	2	0	0	0	19	12	7	0	0	0	46	24	11
Smith County	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	1	1
South Carroll	0	20	15	6	0	0	0	12	15	13	6	0	0	0	13	15	14	6
Stewart County	11	13	2	3	0	0	8	11	14	2	3	0	37	10	12	12	3	3
Sullivan County	0	0	0	4	3	2	0	0	0	28	4	2	0	0	0	34	22	5
Sumner County	0	0	2	0	2	2	0	0	8	6	1	2	0	0	0	8	7	0
Sweetwater	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1
Tennessee School for Blind	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tennessee School for Deaf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Tipton County	0	6	4	1	1	0	0	5	4	4	2	0	0	1	5	3	4	2
Trenton	0	0	0	0	0	1	0	0	0	4	1	0	0	0	0	20	4	1
Trousdale County	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tullahoma	0	8	3	4	1	0	0	4	8	4	3	1	0	2	5	8	5	3
Unicoi County	0	0	27	7	0	0	0	0	25	26	7	0	0	0	17	25	23	7
Union City	0	6	12	1	1	0	0	3	5	11	1	1	19	0	3	5	12	1
Union County	0	0	1	0	0	0	0	0	3	1	1	0	0	0	0	2	1	1
Van Buren County	18	12	13	13	0	0	13	17	11	12	10	0	18	12	17	10	12	12
Warren County	0	0	0	1	1	0	0	0	0	3	1	1	0	0	0	6	3	1
Washington County	0	15	3	2	2	1	0	7	18	5	2	2	0	9	7	19	5	4
Wayne County	0	0	18	11	0	1	0	0	29	23	11	0	0	9	21	38	25	11
Weakley County	0	15	22	8	1	9	0	11	15	20	7	1	0	5	14	18	17	10
West Carroll Special	0	3	1	0	2	0	0	0	5	1	0	2	0	2	0	5	1	0
West Tenn School for Deaf	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
White County	0	5	2	1	0	0	0	5	6	1	2	0	0	2	4	6	2	2
Williamson County	0	0	0	2	2	0	0	0	2	2	0	2	0	0	2	1	1	0
Wilson County	0	0	0	1	1	0	0	0	0	2	1	1	0	0	0	1	3	1
TOTALS	**209**	**985**	**1380**	**634**	**291**	**157**	**181**	**1019**	**1712**	**1734**	**643**	**286**	**615**	**869**	**1482**	**2333**	**1752**	**640**

Because the results of this evaluation to date have found that effects of Pre-K are most evident in Kindergarten, a logical question then is which school systems conduct assessments in Kindergarten, and what are the characteristics of these school systems? Table 17 summarizes, by school system, the number of students who participated in Pre-K in a particular school system for Pre-K program years 2004-2005 and 2005-2006. These students would have been eligible to go on to Kindergarten the following year. Table 17 also summarizes the number of Pre-K participants for whom assessment records are available in Kindergarten. As discussed previously, this represents only a small number of students—approximately 8% of Pre-K participants overall. Thus, many more students participate in Pre-K than are assessed in Kindergarten, and this is true across all school districts.

Table 17. Number of Pre-K Students Assessed in Kindergarten by School System, Pre-K Program Years 2004-2005 and 2005-2006

System	Number of Pre-K Students (Valid Records Only) 2004-2005	Number of Pre-K Students Assessed in Kindergarten 2005-2006	Number of Pre-K Students (Valid Records Only) 2005-2006	Number of Pre-K Students Assessed in Kindergarten 2006-2007
Alamo	0	1	42	38
Alcoa	0	3	19	0
Alvin C York Institute	0	0	0	0
Anderson County	38	0	105	0
Athens	0	0	59	0
Bedford County	0	1	0	0
Bells	0	0	33	0
Benton County	0	0	0	0
Bledsoe County	17	0	38	0
Blount County	65	0	81	0
Bradford	14	0	35	0
Bradley County	0	0	62	0
Bristol	22	0	26	0
Campbell County	15	0	62	0
Cannon County	0	1	27	22
Carroll County	0	0	0	0
Carter County	0	12	0	0
Cheatham County	0	0	38	0
Chester County	0	1	0	0
Claiborne County	26	0	83	0
Clay County	0	0	34	0
Cleveland	44	0	119	0
Clinton	0	0	18	0
Cocke County	0	0	0	0
Coffee County	35	0	54	0
Crockett County	0	0	0	0
Cumberland County	0	0	105	0
Davidson County	175	0	383	0
Dayton	0	0	12	0
Decatur County	0	0	0	0
DeKalb County	30	0	59	0
Dickson County	19	0	40	0
Dyer County	56	0	134	0
Dyersburg	20	0	44	0
Elizabethton	42	0	57	0
Etowah	0	1	0	0
Fayette County	62	0	110	68
Fayetteville	0	0	19	0
Fentress County	0	0	46	0
Franklin	0	0	15	0
Franklin County	63	0	136	0
Gibson County Special School Dist.	36	0	55	0
Giles County	0	4	0	1
Grainger County	0	1	36	31
Greene County	0	0	99	0
Greeneville	87	0	109	0
Grundy County	0	0	14	14
Hamblen County	0	0	55	0
Hamilton County	107	21	320	0
Hancock County	24	18	60	39
Hardeman County	0	4	24	0
Hardin County	0	0	27	0
Hawkins County	17	0	35	0
Haywood County	30	0	32	0
Henderson County	0	1	0	0
Henry County	26	14	56	35

Cont'd **System**	**Number of Pre-K Students (Valid Records Only) 2004-2005**	**Number of Pre-K Students Assessed in Kindergarten 2005-2006**	**Number of Pre-K Students (Valid Records Only) 2005-2006**	**Number of Pre-K Students Assessed in Kindergarten 2006-2007**
Hickman County	0	4	32	30
Hollow Rock Bruceton	0	0	20	0
Houston County	0	0	40	0
Humboldt	41	0	58	0
Humphreys County	16	0	77	0
Huntingdon	0	1	46	34
Jackson County	10	0	22	0
Jefferson County	23	0	100	0
Johnson City	27	0	36	0
Johnson County	0	0	29	0
Kingsport	30	0	65	0
Knox County	47	0	169	0
Lake County	20	17	34	24
Lauderdale County	18	0	86	0
Lawrence County	110	0	158	0
Lebanon	0	0	53	0
Lenoir City	33	0	36	0
Lewis County	0	0	41	39
Lexington	0	1	16	16
Lincoln County	20	0	36	0
Loudon County	20	0	92	0
Macon County	0	0	0	0
Madison County	94	0	152	0
Manchester	0	0	38	0
Marion County	0	1	57	47
Marshall County	0	0	0	0
Maryville	0	0	18	0
Maury County	64	0	65	0
McKenzie	0	1	19	17
McMinn County	9	0	50	0
McNairy County	21	0	81	0
Meigs County	0	0	43	0
Memphis	198	0	675	0
Milan	49	36	60	53
Monroe County	0	0	22	0
Montgomery County	0	0	41	0
Moore County	0	0	0	0
Morgan County	0	0	70	0
Murfreesboro	80	0	151	0
Newport	0	0	0	2
Oak Ridge	0	0	38	0
Obion County	0	1	20	18
Oneida	0	0	34	0
Overton County	0	0	60	0
Paris	0	0	0	0
Perry County	10	10	34	0
Pickett County	0	0	14	13
Polk County	0	0	34	0
Putnam County	66	0	247	0
Rhea County	19	0	54	0
Richard City	0	0	0	0
Roane County	0	0	0	0
Robertson County	0	0	38	0
Rogersville	0	0	14	0
Rutherford County	0	0	72	0
Scott County	52	0	123	0
Sequatchie County	0	5	0	0
Sevier County	20	0	94	0
Shelby County	18	0	95	0
Smith County	0	0	30	0

Cont'd **System**	**Number of Pre-K Students (Valid Records Only) 2004-2005**	**Number of Pre-K Students Assessed in Kindergarten 2005-2006**	**Number of Pre-K Students (Valid Records Only) 2005-2006**	**Number of Pre-K Students Assessed in Kindergarten 2006-2007**
South Carroll	19	0	23	0
Stewart County	6	8	49	37
Sullivan County	21	0	63	0
Sumner County	0	0	0	0
Sweetwater	0	0	23	0
Tennessee School for Blind	0	0	0	0
Tennessee School for Deaf	0	0	0	0
Tipton County	0	0	159	0
Trenton	15	0	35	0
Trousdale County	0	0	0	0
Tullahoma	0	0	0	0
Unicoi County	30	0	80	0
Union City	0	0	21	19
Union County	0	0	20	0
Van Buren County	21	13	22	18
Warren County	0	0	37	0
Washington County	0	0	0	0
Wayne County	46	0	84	0
Weakley County	2	0	32	0
West Carroll Special School District	0	0	20	0
West Tennessee School for Deaf	0	0	0	0
White County	0	0	21	0
Williamson County	0	0	104	0
Wilson County	0	0	0	0
TOTALS	**2,345**	**181**	**7,599**	**615**

To synthesize the information presented in Tables 15-17, although overall, 80% of Tennessee school systems are represented in the present evaluation's analysis of academic achievement, approximately 16% of school systems are represented in the analysis of *Kindergarten* assessments. This is largely a result of the infrequency with which assessments are conducted in Kindergarten. A similar pattern exists for First and (to a lesser extent) Second Grade. A logical question, then, is what are the characteristics of these school systems? What systematic differences might there be between districts that assess (particularly in Kindergarten) and districts that do not assess in these grades?

To attempt to address this question, descriptive/demographic data for Tennessee's school systems were obtained from the National Center for Education Statistics and the 2000 Census. Given the priorities and target populations of the Voluntary Pre-K program as well as results of other conceptually similar studies on the impact of Pre-K participation, we identified a subset of "risk factors" to examine to determine whether there were systematic differences between the districts represented in the present evaluation (because they chose to conduct assessments in Grades K-2), and whether these characteristics might be controlled for in analysis of student academic achievement.

The table in Appendix B summarizes the characteristics of school systems according to their urban-centric locale, percent of children receiving FRPL, percent of minority/nonwhite students in the district, and total expenditures per student (variables from NCES), as well as the median household income in the district and the percent of children living in poverty in the district (variables from the 2000 Census, obtained from NCES).

We attempted to compare the characteristics of districts that conducted assessments in Grades K-2 relative to districts that did not assess in these grades, so as to better understand the potential impact of system-level characteristics on student outcomes. Although these are imperfect indicators, we felt they would reasonably allow us to detect potentially important differences between the two groups of school systems.

Simple *t*-tests were used to compare systems that assessed vs. systems that did not assess in terms of child poverty in the school district, median family income in the school district, the percent of minority/nonwhite students in the school district, percent of students receiving free/reduced price lunch in the school district, and total expenditures in the district. We examined separately whether there were differences due to whether or not systems assessed in Kindergarten, First Grade, and Second Grade, as well as whether there were differences between systems that assessed at any point in Kindergarten through Second Grade as compared to systems who did not conduct any assessments in these grades.

Overall there were few differences in terms of these indicators between districts that assessed versus those that did not assess in Kindergarten through Second Grade. In 2004-2005, systems that assessed in Kindergarten had a slightly higher percentage of students receiving free/reduced price lunch (mean = 54.5%) as compared to systems that did not assess in Kindergarten (mean = 47.3%, $t(134) = 2.35$, $p < 0.05$). A similar pattern was observed for districts that elected to assess in Kindergarten in 2005-2006, such that systems that assessed had a higher percentage of FRPL students (mean = 52.1%) as compared to systems that did not conduct these assessments in Kindergarten (mean = 47.7%, $t(72) = 2.20$, $p < 0.05$). The only other difference observed among systems that did/did not assess was that systems that assessed in First Grade in 2005-2006 had a slightly higher percentage of minority/non-white students (mean = 17.7%) compared to systems that did not assess (mean = 11.9%, $t(103) = 1.96$, $p = 0.05$), but this was not a reliable pattern.

These differences, while acknowledged, do not pose a significant threat to the interpretation of the results of the present evaluation, given that FRPL is a known risk factor that was incorporated into the design as a control variable. Further, student race was also identified as a potential risk factor and statistical controls were also built into the design to account for potential differences due to race and gender.

We also examined whether there were differences in terms of locale, or geographical type of school system. The chi-square test for independence was used to examine whether there were differences in the distributions of locale (according to the NCES classification) as a function of whether or not the school system assessed in Kindergarten-Second Grade. Separate tests were run for Kindergarten, First, and Second Grade for 2004-2005 and for 2005-2006; the chi-square statistic did not reach conventional levels of statistical significance for any test (all *p*'s > 0.30), indicating that there was not a statistically significant difference between the groups. See Tables 18 and 19 for a summary.

Table 18. Locale of School Systems that Conducted/Did Not Conduct Assessments in Kindergarten – Second Grade, 2004-2005

Locale	District assessed in Kindergarten 04-05				District assessed in First Grade 04-05			
	Did not assess		Assessed		Did not assess		Assessed	
	N	%	N	%	N	%	N	%
Large city	1	0.9%	1	4.5%	1	1.5%	1	1.4%
Mid-size city	8	7.0%	0	0.0%	4	6.2%	4	5.6%
Urban fringe of large city	8	7.0%	0	0.0%	7	10.8%	1	1.4%
Urban fringe of mid-size city	14	12.3%	4	18.2%	10	15.4%	8	11.3%
Large town	2	1.8%	0	0.0%	1	1.5%	1	1.4%
Small town	24	21.1%	4	18.2%	11	16.9%	17	23.9%
Rural, outside of CBSA/MSA	43	37.7%	9	40.9%	25	38.5%	27	38.0%
Rural, inside of CBSA/MSA	14	12.3%	4	18.2%	6	9.2%	12	16.9%

Locale	District assessed in Second Grade 04-05				District assessed in Any Grade K – 2, 04-05			
	Did not assess		Assessed		Did not assess		Assessed	
	N	%	N	%	N	%	N	%
Large city	0	0.0%	2	2.2%	0	0.0%	2	2.0%
Mid-size city	3	7.0%	5	5.4%	3	8.3%	5	5.0%
Urban fringe of large city	5	11.6%	3	3.2%	5	13.9%	3	3.0%
Urban fringe of mid-size city	4	9.3%	14	15.1%	4	11.1%	14	14.0%
Large town	1	2.3%	1	1.1%	1	2.8%	1	1.0%
Small town	9	20.9%	19	20.4%	7	19.4%	21	21.0%
Rural, outside of CBSA/MSA	16	37.2%	36	38.7%	13	36.1%	39	39.0%
Rural, inside of CBSA/MSA	5	11.6%	13	14.0%	3	8.3%	15	15.0%

Table 19. Locale of School Systems that Conducted/Did Not Conduct Assessments in Kindergarten – Second Grade, 2005-2006

Locale	District assessed in Kindergarten 05-06				District assessed in First Grade 05-06			
	Did not assess		Assessed		Did not assess		Assessed	
	N	%	N	%	N	%	N	%
Large city	2	1.8%	0	.0%	1	1.4%	1	1.6%
Mid-size city	9	8.2%	0	.0%	5	6.9%	4	6.3%
Urban fringe of large city	8	7.3%	0	.0%	7	9.7%	1	1.6%
Urban fringe of mid-size city	13	11.8%	4	15.4%	9	12.5%	8	12.5%
Large town	2	1.8%	0	.0%	2	2.8%	0	0.0%
Small town	23	20.9%	5	19.2%	14	19.4%	14	21.9%
Rural, outside of CBSA/MSA	41	37.3%	11	42.3%	26	36.1%	26	40.6%
Rural, inside of CBSA/MSA	12	10.9%	6	23.1%	8	11.1%	10	15.6%
Locale	District assessed in Second Grade 05-06				District assessed in Any Grade K – 2, 05-06			
	Did not assess		Assessed		Did not assess		Assessed	
	N	%	N	%	N	%	N	%
Large city	0	0.0%	2	2.1%	0	0.0%	2	2.0%
Mid-size city	3	7.1%	6	6.4%	3	8.3%	6	6.0%
Urban fringe of large city	4	9.5%	4	4.3%	4	11.1%	4	4.0%
Urban fringe of mid-size city	5	11.9%	12	12.8%	5	13.9%	12	12.0%
Large town	1	2.4%	1	1.1%	1	2.8%	1	1.0%
Small town	10	23.8%	18	19.1%	7	19.4%	21	21.0%
Rural, outside of CBSA/MSA	16	38.1%	36	38.3%	13	36.1%	39	39.0%
Rural, inside of CBSA/MSA	3	7.1%	15	16.0%	3	8.3%	15	15.0%

An additional analysis was run using these system-level variables as covariates in the overall models (growth curve models, difference score models, and single-time-point models). The results of all the analyses were virtually unchanged, with the exception that second-grade effects were no longer statistically significant. Kindergarten and First Grade effects (as reported on pages 21-33) remained significant at the $p < 0.01$ level. That is, when the models control for environmental sources of variation in the school system, the differences between the Pre-K and non-Pre-K groups beyond the First Grade are no longer statistically significant. However, the effects observed in Kindergarten and First Grade cannot be explained by these additional covariates, and thus may reflect the unique effect of Pre-K on student assessments in these grades. Means, *p*-values, and effect sizes for the analysis incorporating the additional system-level variables can be found in Appendix A.

Pre-K Curricula

Another program characteristic that may be relevant to consider is the type (or types) of curriculum students were exposed to while attending Pre-K. As was discussed previously, starting in the 2005-2006 school year, Tennessee's Pre-K programs were required to align their curricula with state academic standards. The Office of Early Learning provided SRG with the curriculum used at each Pre-K site for 2004-2005 and 2005-2006. SRG then linked this information with the Pre-K demographic file in order to determine the number of students exposed to each curriculum type used, as well as the number of sites attended by children with valid Pre-K records using a particular type. Of the 2,345 Pre-K students with valid records for the 2004-2005 school year, 1,912 (81.5%) can be linked to curriculum information. Of the 7,599 Pre-K students with valid records for the 2005-2006 school year, 7,000 (92.1%) can be linked to curriculum information. The results are provided in Tables

20 and 21. A small number of sites used more than one type of curriculum, and so the number of Pre-K students will not total to 1,912 in Table 20 or to 7,599 in Table 21. Additionally, it is important to keep in mind that Tables 20 and 21 do not include an exhaustive list of Pre-K curricula used in Tennessee in the 2004-2005 and 2005-2006 school years, but rather those types used at sites for which there are valid Pre-K student records for these years.

Table 20. Number of Pre-K Sites Using Each Type of Curriculum in 2004-2005 and the Number of Pre-K Students Exposed to Each Type

Curriculum Name	Number of Sites Using this Curriculum in 2004-2005	Number of Pre-K Students Exposed to this Curriculum in 2004-2005
ABEKA	1	18
Assessment Evaluation and Programming System (AEPS)	1	26
Bright Beginnings *	5	87
Bright Start	1	12
Core Knowledge	2	5
Creative Curriculum *	40	773
Developmental Appropriate Practice	2	37
Doors to Discovery *	6	131
Funshine	6	29
Growing with Math	9	200
High Reach	3	62
High Scope	9	174
Individualized/System-Designed/Teacher Made	3	60
Integrated Thematic Instruction	4	47
Language for Learners	3	55
Let's Learn and Play	1	18
Letter People *	15	294
Montessori	3	41
Move it Math	6	29
New Planning Guide	1	23
Pebble Soup	1	23
Rigby	3	56
Saxon Early Learning	5	99
Scholastic	1	10
Standards and National Association for the Education of Young Children	1	42
Thematic Units	1	30
We Can!	1	17
Wee Care	1	20

Note: * indicates this curriculum was studied as part of the National Center for Education Research Preschool Curriculum Evaluation Research Initiative

Table 21. Number of Pre-K Sites Using Each Type of Curriculum in 2005-2006 and the Number of Pre-K Students Exposed to Each Type

Curriculum Name	Number of Sites Using this Curriculum in 2005-2006	Number of Pre-K Students Exposed to this Curriculum in 2005-2006
ABEKA	1	18
Bandstreet	3	63
Bright Beginnings *	1	22
Bright Start	1	11
Creative Curriculum *	109	2,268
County Curriculum	5	104
DLM	17	340
DLM Express	6	131
Doors to Discovery *	14	248
ECLS	1	22
Frog Street Press	1	21
Harcourt	6	111
High Reach	2	33
High Scope	9	196
Houghton Mifflin	20	513
Language for Learners	8	152
Letter People *	16	345
Little People	3	71
Montessori	4	107
Open Court	1	26
OWL	65	1,267
Saxon Early Learning	13	332
Scholastic	1	13
Scott Foresman	5	117
Teacher Made	18	399
TN - ELDS	9	138
We Can!	1	19
Wings	4	82
Wright	4	62

Note: * indicates this curriculum was studied as part of the National Center for Education Research Preschool Curriculum Evaluation Research Initiative

In both school years, Creative Curriculum was, by far, the most commonly used curriculum. In 2004-2005, Letter People was the second most commonly used curriculum, whereas OWL was the second most commonly used curriculum in 2005-2006. Despite some shifts in the types of curriculum used and the number of Pre-K exposed to each type between 2004-2005 and 2005-2006, however, the key finding that emerges from Tables 20 and 21 is that many different types of curricula were used across Tennessee's Pre-K sites in both the 2004-2005 and 2005-2006 school years.

In 2002, the Institute of Education Sciences (IES) began the Preschool Curriculum Evaluation Research (PCER) initiative. The PCER engaged twelve research teams to conduct rigorous experimental evaluations of 14 preschool curricula using a common set of measures. The cohort of children studied began preschool in the summer-fall of 2003, which corresponds to Cohort 3 of the present evaluation (i.e., students who were enrolled in Pre-K in 2003-2004 and entered Kindergarten in 2004-2005).

The PCER initiative studied the impact of 14 preschool curricula in 13 states (including Tennessee) on an array of outcomes, including reading, phonological awareness, language, mathematics, and behavior (student-level outcomes) and classroom quality, teacher-child interaction, and instructional practices (classroom-level outcomes). Four of the curricula studied in the PCER initiative were also in use in Tennessee in 2004-2005 and 2005-2006 (as noted in Tables 20 and 21): Bright Beginnings, Creative Curriculum, Doors to Discovery, and Let's Begin with the Letter People.

Although the PCER report identified some positive effects in various domains attributable to the different curricula both in Pre-K and in Kindergarten, the impacts were somewhat inconsistent, and

fewer than half of the curricula studied were associated with any positive impacts in any domain.[42] Of the curricula in use in Tennessee:

- *Bright Beginnings* (studied in Tennessee) was not associated with any significant impacts on Pre-kindergarten or Kindergarten student-level outcomes. However, a positive impact was found at the classroom level on early literacy instruction and phonological awareness instruction.
- *Creative Curriculum* was studied both in Tennessee as well as with a sample of Head Start students from Georgia and North Carolina. Although no impacts were found for student outcomes in either sample, some positive impacts were found at the classroom level among the Head Start sample.
- *Doors to Discovery* and *Let's Begin with the Letter People* were studied using a sample of students attending Head Start and public Pre-kindergarten (Title I and non-Title I) programs in Texas. No impacts on the Pre-kindergarten or Kindergarten student-level outcomes were found using either curricula, but some positive impacts were found at the classroom level for both.

There is a great variety in the curricula used statewide. Further, there is significant variation in exposure: a number of curricula are used at only one site, and some sites actually use multiple curricula. Given all these factors, additional analysis linking student outcomes to Pre-K curricula is not recommended using the present research design. However, type of curriculum is clearly a relevant consideration to the overarching research question of Pre-K program effectiveness, and future evaluations (including the evaluation being conducted by TDOE and the Peabody Research Institute at Vanderbilt University) should explore further.

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[42] Preschool Curriculum Evaluation Research Consortium (2008). *Effects of Preschool Curriculum Programs on School Readiness* (NCER 2008-2009). Washington, DC: National Center for Education Research, Institute of Education Sciences, U.S. Department of Education. Washington, DC: U.S. Government Printing Office. http://ies.ed.gov/ncer/pubs/20082009/index.asp

General Summary and Conclusions

This report has attempted to clarify and extend the findings presented in this evaluation to date, and specifically to address potential confounds or sources of bias in the analysis for the Second Interim Report. After extensive review of the data and additional exploration of the results, we find the same persistent pattern of results: Pre-K participation is associated with a small but reliable effect on student outcomes in Kindergarten, specifically among economically disadvantaged students. These effects are detectable (but diminished) in First Grade and by Second Grade the difference between Pre-K students and a reasonably comparable group of non-Pre-K students is negligible.

In terms of interpreting these results, which are consistent with the findings of many other conceptually similar studies of Pre-K programs, it appears that the Voluntary Pre-K program is meeting its primary objective in terms of improving participating students' school readiness. However, without sustained efforts to address the many risk factors that are prevalent among this group, this intervention in itself may not be sufficient to close persistent gaps in student achievement. In this respect, evaluating the impact of Pre-K on the basis of its long-term effects is analogous to evaluating the effectiveness of prenatal care on the basis of a child's health at age 18. One might argue that the benefits of prenatal care (and Pre-K) would be (and are) most obvious in the short term (i.e., Kindergarten). This is not to say that the benefits of the program do not persist in the long term, but due to many additional sources of variation that come into play over time, they are increasingly difficult to isolate—particularly in an analysis of secondary data, which does not benefit from methodological controls—and may ultimately be overshadowed by other, more potent sources of variation such as socioeconomic disadvantage. Although the effects of Pre-K on long-term academic achievement are not evident in the present study, the lack of a statistically significant difference in measures of student achievement in the long term cannot logically be attributed to an ineffective Pre-K intervention.

A systematic assessment of Pre-K students prior to starting Kindergarten would likely provide a more valid evaluation of the true impact of the Pre-K program. Ideally, for example, a "Kindergarten Readiness" assessment administered to all students at Kindergarten entry, with more detailed data on entering students' experiences and outcomes in preschool or Pre-Kindergarten, would provide a more objective and appropriate indication as to the true impact of this intervention, and a baseline against which to measure students' progress in higher grades. However, in the absence of such data, the present evaluation has used the best data available and the most rigorous techniques possible given the nature of the data at hand. The results point to one clear pattern of student outcomes: Pre-K students, particularly those who experience economic disadvantage, perform better in the short term on assessments in Kindergarten, and to a lesser extent, on assessments in First and Second Grade, relative to a comparable group of peers who did not participate in the state Pre-K program.

Next Steps and Upcoming Reports

The next report will be a Third Interim Report describing outcomes from the 2007-2008 school year. Following this, there will be two remaining reports for this evaluation: an Annual Report describing the outcomes for the 2008-2009 school year and a Final Comprehensive Report that will attempt to construct longitudinal models encompassing K-5 outcomes associated with all years of the Pre-K program to date.

A key advantage of the subsequent reports is that Pre-K participation will be identified by the EIS rather than the Pre-K demographic file. As mentioned previously, starting with the 2006-2007 school year, the Tennessee EIS began including data for Pre-K students. Thus, the next report will include the first cohort of Kindergarten students who attended Pre-K in 2006-2007. Because the EIS provides more complete coverage of information than the Pre-K demographic file, we will be able to further reduce instances of missing demographic data for students. Along similar lines, there are fewer cases of missing unique student identifiers (i.e., Social Security Number, provided to us in encrypted form) in the EIS as compared to the Pre-K demographic file. As mentioned previously, students for whom no Social Security Number was provided cannot be included in the analyses.

Further, although the Pre-K demographic file will continue to be used to identify Pre-K students from previous years, the availability of additional years of assessment and EIS data will allow us to cross-check the records of more Pre-K students who could not be included in previous analyses because their records contained questionable or inconsistent information.

Additionally, we will continue to discuss with the TDOE Office of Early Learning ways to explore and refine the analyses conducted in the course of this evaluation, with the ultimate goal of informing them and the Office of the Comptroller as to the overall impact of the Pre-K program as measured by student assessments in Grades K-5 as well as nuances associated with unique attributes of the Pre-K program.

Appendix A

Means, p-values, and Effect Sizes for all Analyses Reported

I. Analyses using Full Sample (pp. 21-33)

A. Growth Curve Models

Grade Level	Assessment	Comparison	Model-Implied Adjusted Mean Scores		*p*-value	Effect Size (d)
			Pre-K	Non-Pre-K		
Kindergarten	Reading	Overall	559.55	556.06	0.00703	0.0439
		FRPL Only	555.19	550.52	0.00007	0.0649
		Non-FRPL Only	563.90	561.60	0.31795	0.0163
	Language Arts	Overall	561.21	557.28	0.01977	0.0380
		FRPL Only	556.01	550.21	0.00014	0.0620
		Non-FRPL Only	566.40	564.35	0.49338	0.0112
	Mathematics	Overall	520.88	514.79	0.00014	0.0620
		FRPL Only	513.98	506.19	0.00000	0.0888
		Non-FRPL Only	527.78	523.39	0.12470	0.0250
Second Grade	Reading	Overall	616.42	618.35	0.01911	0.0382
		FRPL Only	611.47	611.22	0.73552	0.0055
		Non-FRPL Only	621.37	625.47	0.00542	0.0453
	Language Arts	Overall	624.67	625.01	0.72118	0.0058
		FRPL Only	619.51	617.32	0.01057	0.0417
		Non-FRPL Only	629.82	632.70	0.09744	0.0270
	Mathematics	Overall	569.86	570.23	0.66714	0.0070
		FRPL Only	565.53	563.46	0.00607	0.0447
		Non-FRPL Only	574.19	577.00	0.06755	0.0297
Third Grade	Reading	Overall	485.76	486.96	0.05042	0.0343
		FRPL Only	482.46	481.59	0.12492	0.0269
		Non-FRPL Only	489.06	492.32	0.00261	0.0527
	Mathematics	Overall	476.10	477.03	0.13525	0.0262
		FRPL Only	473.41	472.22	0.03972	0.0360
		Non-FRPL Only	478.78	481.84	0.00578	0.0483
	Science	Overall	202.33	202.89	0.13470	0.0263
		FRPL Only	200.15	199.50	0.03280	0.0615
		Non-FRPL Only	204.50	206.27	0.00759	0.0469
	Social Studies	Overall	201.04	201.34	0.43356	0.0138
		FRPL Only	197.99	197.44	0.12734	0.0268
		Non-FRPL Only	204.09	205.24	0.09206	0.0296
Fifth Grade	Reading	Overall	510.29	512.72	0.00963	0.0453
		FRPL Only	505.35	505.46	0.89963	0.0022
		Non-FRPL Only	515.23	519.98	0.00411	0.0503
	Mathematics	Overall	512.09	512.79	0.45779	0.0130
		FRPL Only	508.14	506.82	0.13422	0.0262
		Non-FRPL Only	516.04	518.76	0.10049	0.0288
	Science	Overall	205.59	205.78	0.74057	0.0058
		FRPL Only	202.52	202.17	0.51369	0.0115
		Non-FRPL Only	208.65	209.38	0.46780	0.0127
	Social Studies	Overall	204.99	206.57	0.00797	0.0466
		FRPL Only	202.96	202.85	0.84564	0.0034
		Non-FRPL Only	207.02	210.29	0.00183	0.0547

B. Difference Score Models

Grade Level	Assessment	Comparison	Model-Implied Adjusted Mean Scores		*p*-value	Effect Size (d)
			Pre-K	Non-Pre-K		
First Grade	Vocabulary	Overall	564.64	563.70	0.46980	0.0129
		FRPL Only	558.37	555.86	0.02161	0.0410
		Non-FRPL Only	570.91	571.54	0.79151	0.0047
	Word Analysis	Overall	592.46	590.40	0.07939	0.0314
		FRPL Only	588.34	583.52	0.0000	0.0876
		Non-FRPL Only	596.58	597.28	0.74422	0.0058
	Math Computation	Overall	502.86	501.21	0.25008	0.0205
		FRPL Only	500.01	496.19	0.00137	0.0570
		Non-FRPL Only	505.70	506.23	0.83831	0.0036
	Social Studies	Overall	593.99	591.25	0.04087	0.0391
		FRPL Only	588.82	585.15	0.00114	0.0622
		Non-FRPL Only	599.16	597.35	0.45666	0.0142
	Science	Overall	573.14	570.24	0.07507	0.0339
		FRPL Only	567.51	563.28	0.00206	0.0587
		Non-FRPL Only	578.76	577.19	0.59461	0.0101
Second Grade	Vocabulary	Overall	598.94	599.90	0.34573	0.0168
		FRPL Only	593.48	592.00	0.09832	0.0295
		Non-FRPL Only	604.40	607.79	0.06075	0.0334
	Word Analysis	Overall	622.77	622.20	0.53016	0.0112
		FRPL Only	617.67	615.69	0.01414	0.0439
		Non-FRPL Only	627.86	628.70	0.60527	0.0092
	Math Computation	Overall	547.17	546.82	0.74246	0.0059
		FRPL Only	542.11	539.41	0.00495	0.0501
		Non-FRPL Only	552.22	554.22	0.30117	0.0184
	Social Studies	Overall	610.87	612.84	0.05955	0.0360
		FRPL Only	605.28	602.77	0.00794	0.0508
		Non-FRPL Only	616.45	622.91	0.00056	0.0660
	Science	Overall	589.61	589.59	0.99163	0.0002
		FRPL Only	584.30	581.10	0.00497	0.0535
		Non-FRPL Only	594.91	598.08	0.16260	0.0266

C. Single-Time-Point Models

Grade Level	Assessment	Comparison	Model-Implied Adjusted Mean Scores		*p*-value	Effect Size (d)
			Pre-K	Non-Pre-K		
Second Grade	Spelling	Overall	587.26	586.26	0.46790	0.01481
		FRPL Only	580.30	576.52	0.00207	0.06287
		Non-FRPL Only	594.22	596.00	0.46816	0.01480

II. Analysis of Students Matched in Kindergarten Only (pp. 33-36)

A. Growth Curve Models

Grade Level	Assessment	Comparison	Model-Implied Adjusted Mean Scores		*p*-value	Effect Size (d)
			Pre-K	Non-Pre-K		
Kindergarten	Reading	Overall	551.84	549.69	0.19960	0.0486
		FRPL Only	546.94	543.35	0.02524	0.0849
		Non-FRPL Only	556.73	556.02	0.80895	0.0092
	Language Arts	Overall	552.33	550.55	0.40350	0.0317
		FRPL Only	547.16	543.92	0.11157	0.0603
		Non-FRPL Only	557.50	557.18	0.93258	0.0032
	Mathematics	Overall	519.11	512.89	0.00469	0.1073
		FRPL Only	510.41	504.71	0.00677	0.1028
		Non-FRPL Only	527.81	521.07	0.08033	0.0663
Second Grade	Reading	Overall	623.38	623.19	0.95364	0.0022
		FRPL Only	618.81	618.65	0.95588	0.0021
		Non-FRPL Only	627.94	627.73	0.97032	0.0014
	Language Arts	Overall	629.85	626.51	0.42751	0.0301
		FRPL Only	623.87	622.45	0.71378	0.0139
		Non-FRPL Only	635.83	630.57	0.47828	0.0269
	Mathematics	Overall	573.12	572.60	0.88221	0.0056
		FRPL Only	569.34	568.47	0.78702	0.0102
		Non-FRPL Only	576.90	576.73	0.97789	0.0011

B. Difference Score Models

Grade Level	Assessment	Comparison	Model-Implied Adjusted Mean Scores		*p*-value	Effect Size (d)
			Pre-K	Non-Pre-K		
First Grade	Vocabulary	Overall	563.17	562.85	0.93881	0.0048
		FRPL Only	560.16	559.28	0.80572	0.0155
		Non-FRPL Only	566.18	566.42	0.97401	0.0020
	Word Analysis	Overall	592.22	590.07	0.55677	0.0369
		FRPL Only	587.05	585.67	0.66247	0.0274
		Non-FRPL Only	597.39	594.46	0.65632	0.0280
	Math Computation	Overall	501.80	501.40	0.92200	0.0062
		FRPL Only	494.50	495.24	0.83134	0.0134
		Non-FRPL Only	509.09	507.55	0.83264	0.0133
	Social Studies	Overall	599.19	594.64	0.19900	0.0814
		FRPL Only	592.94	588.04	0.11761	0.0992
		Non-FRPL Only	605.43	601.23	0.50649	0.0421
	Science	Overall	580.83	575.38	0.23337	0.0756
		FRPL Only	574.09	569.46	0.25161	0.0727
		Non-FRPL Only	587.57	581.29	0.44283	0.0487
Second Grade	Vocabulary	Overall	599.19	602.59	0.50672	0.0417
		FRPL Only	593.70	595.15	0.75394	0.0197
		Non-FRPL Only	604.67	610.02	0.55289	0.0373
	Word Analysis	Overall	622.98	620.68	0.61300	0.0318
		FRPL Only	620.16	618.89	0.75769	0.0194
		Non-FRPL Only	625.80	622.47	0.67705	0.0262
	Math Computation	Overall	559.54	552.34	0.17129	0.0860
		FRPL Only	554.80	545.12	0.04326	0.1271
		Non-FRPL Only	564.27	559.55	0.60904	0.0321
	Social Studies	Overall	624.95	616.80	0.07090	0.1145
		FRPL Only	621.96	615.25	0.11958	0.0987
		Non-FRPL Only	627.93	618.34	0.22088	0.0776
	Science	Overall	600.13	597.40	0.63794	0.0298
		FRPL Only	595.27	597.13	0.73691	0.0213
		Non-FRPL Only	604.98	597.67	0.46773	0.0460

C. Single-Time-Point Models

Grade Level	Assessment	Comparison	Model-Implied Adjusted Mean Scores		*p*-value	Effect Size (d)
			Pre-K	Non-Pre-K		
Second Grade	Spelling	Overall	575.94	577.80	0.78312	0.0252
		FRPL Only	578.78	569.85	0.14749	0.1326
		Non-FRPL Only	573.10	585.74	0.28116	0.0986

III. Analysis of Records with Complete Records in Kindergarten Through Second Grade (pp. 37-39)

A. Growth Curve Models

Grade Level	Assessment	Comparison	Model-Implied Adjusted Mean Scores		*p*-value	Effect Size (d)
			Pre-K	Non-Pre-K		
Kindergarten	Reading	Overall	556.90	555.94	0.79370	0.0234
		FRPL Only	551.95	550.25	0.62743	0.0434
		Non-FRPL Only	561.85	561.63	0.97255	0.0031
	Language Arts	Overall	559.82	557.32	0.58683	0.0486
		FRPL Only	555.91	551.18	0.28178	0.0963
		Non-FRPL Only	563.72	563.45	0.97285	0.0030
	Mathematics	Overall	528.37	514.84	0.00397	0.2586
		FRPL Only	516.75	509.12	0.08751	0.1530
		Non-FRPL Only	539.99	520.55	0.01722	0.2136
Second Grade	Reading	Overall	623.14	623.73	0.87161	0.0144
		FRPL Only	619.23	619.26	0.99207	0.0009
		Non-FRPL Only	627.04	628.19	0.85682	0.0161
	Language Arts	Overall	631.51	628.71	0.56301	0.0517
		FRPL Only	623.87	624.54	0.88343	0.0131
		Non-FRPL Only	639.14	632.88	0.45624	0.0666
	Mathematics	Overall	577.77	574.51	0.42534	0.0713
		FRPL Only	573.10	569.99	0.42540	0.0713
		Non-FRPL Only	582.44	579.03	0.63111	0.0429

B. Difference Score Models

Grade Level	Assessment	Comparison	Model-Implied Adjusted Mean Scores		*p*-value	Effect Size (d)
			Pre-K	Non-Pre-K		
First Grade	Vocabulary	Overall	567.58	565.40	0.68653	0.0374
		FRPL Only	569.16	562.66	0.19147	0.1211
		Non-FRPL Only	565.99	568.13	0.82001	0.0211
	Word Analysis	Overall	593.41	595.24	0.69645	0.0361
		FRPL Only	589.50	589.25	0.95489	0.0052
		Non-FRPL Only	597.32	601.23	0.63412	0.0441
	Math Computation	Overall	502.61	504.38	0.73666	0.0311
		FRPL Only	499.11	498.11	0.83718	0.0190
		Non-FRPL Only	506.11	510.65	0.62227	0.0456
	Social Studies	Overall	601.41	595.17	0.20010	0.1189
		FRPL Only	595.94	589.41	0.16519	0.1288
		Non-FRPL Only	606.88	600.93	0.48052	0.0654
	Science	Overall	583.50	576.36	0.22742	0.1120
		FRPL Only	576.47	571.23	0.35872	0.0851
		Non-FRPL Only	590.52	581.48	0.37766	0.0818
Second Grade	Vocabulary	Overall	601.65	605.14	0.51722	0.0600
		FRPL Only	598.55	597.37	0.81267	0.0219
		Non-FRPL Only	604.75	612.90	0.38667	0.0802
	Word Analysis	Overall	623.18	623.55	0.93675	0.0073
		FRPL Only	621.20	620.97	0.95670	0.0050
		Non-FRPL Only	625.15	626.13	0.90494	0.0111
	Math Computation	Overall	560.19	555.18	0.34198	0.0880
		FRPL Only	557.26	547.50	0.04504	0.1860
		Non-FRPL Only	563.11	562.86	0.97799	0.0026
	Social Studies	Overall	625.11	617.59	0.12228	0.1434
		FRPL Only	622.03	616.23	0.21568	0.1149
		Non-FRPL Only	628.18	618.95	0.27349	0.1016
	Science	Overall	600.81	598.53	0.69933	0.0358
		FRPL Only	595.78	598.33	0.65377	0.0416
		Non-FRPL Only	605.84	598.73	0.48794	0.0643

C. Single-Time-Point Models

Grade Level	Assessment	Comparison	Model-Implied Adjusted Mean Scores		*p*-value	Effect Size (d)
			Pre-K	Non-Pre-K		
Second Grade	Spelling	Overall	578.24	580.32	0.76058	0.02924
		FRPL Only	580.21	572.24	0.21106	0.12011
		Non-FRPL Only	576.26	588.39	0.30744	0.09798

IV. Analyses using Full Sample and Controlling for District-Level Characteristics (pp. 54-56)

A. Growth Curve Models

Grade Level	Assessment	Comparison	Model-Implied Adjusted Mean Scores		p-value	Effect Size (d)
			Pre-K	Non-Pre-K		
Kindergarten	Reading	Overall	557.82	555.39	0.06959	0.0313
		FRPL Only	553.71	549.44	0.00067	0.0587
		Non-FRPL Only	561.92	561.34	0.80589	0.0042
	Language Arts	Overall	558.45	555.94	0.12624	0.0264
		FRPL Only	554.10	549.33	0.00195	0.0014
		Non-FRPL Only	562.79	562.55	0.93310	0.0535
	Mathematics	Overall	519.51	515.02	0.00243	0.0522
		FRPL Only	513.13	506.41	0.00000	0.0832
		Non-FRPL Only	525.89	523.62	0.38334	0.0150
Second Grade	Reading	Overall	616.36	618.30	0.02463	0.0388
		FRPL Only	611.39	611.02	0.63257	0.0082
		Non-FRPL Only	621.33	625.58	0.00607	0.0473
	Language Arts	Overall	625.09	625.42	0.75278	0.0054
		FRPL Only	618.94	617.10	0.05525	0.0331
		Non-FRPL Only	631.24	633.74	0.18807	0.0227
	Mathematics	Overall	570.11	570.43	0.74305	0.0056
		FRPL Only	565.31	563.83	0.09061	0.0292
		Non-FRPL Only	574.91	577.03	0.22407	0.0209
Third Grade	Reading	Overall	485.96	487.00	0.09957	0.0303
		FRPL Only	482.50	481.47	0.08628	0.0315
		Non-FRPL Only	489.41	492.53	0.00556	0.0510
	Mathematics	Overall	476.16	477.16	0.12147	0.0285
		FRPL Only	473.45	472.24	0.05055	0.0359
		Non-FRPL Only	478.86	482.08	0.00529	0.0513
	Science	Overall	202.32	202.82	0.19267	0.0240
		FRPL Only	200.29	199.48	0.02828	0.0404
		Non-FRPL Only	204.34	206.16	0.00816	0.0487
	Social Studies	Overall	200.98	201.19	0.59074	0.0099
		FRPL Only	198.08	197.36	0.06109	0.0345
		Non-FRPL Only	203.87	205.01	0.10680	0.0297
Fifth Grade	Reading	Overall	510.35	512.81	0.01140	0.0465
		FRPL Only	505.72	505.77	0.95281	0.0011
		Non-FRPL Only	514.98	519.85	0.00442	0.0523
	Mathematics	Overall	512.27	512.97	0.47443	0.0131
		FRPL Only	508.59	507.15	0.12735	0.0280
		Non-FRPL Only	515.94	518.79	0.09881	0.0303
	Science	Overall	205.53	205.61	0.87979	0.0028
		FRPL Only	202.65	202.28	0.52951	0.0116
		Non-FRPL Only	208.40	208.94	0.60422	0.0096
	Social Studies	Overall	205.05	206.49	0.02013	0.0428
		FRPL Only	203.24	203.00	0.67928	0.0076
		Non-FRPL Only	206.85	209.97	0.00406	0.0530

B. Difference Score Models

Grade Level	Assessment	Comparison	Model-Implied Adjusted Mean Scores		*p*-value	Effect Size (d)
			Pre-K	Non-Pre-K		
First Grade	Vocabulary	Overall	564.36	563.26	0.42741	0.0150
		FRPL Only	557.19	555.35	0.12353	0.0291
		Non-FRPL Only	571.52	571.17	0.88938	0.0026
	Word Analysis	Overall	592.84	590.50	0.05840	0.0359
		FRPL Only	587.41	583.28	0.00012	0.0728
		Non-FRPL Only	598.27	597.71	0.80149	0.0048
	Math Computation	Overall	503.51	501.42	0.16331	0.0263
		FRPL Only	499.51	495.56	0.00234	0.0575
		Non-FRPL Only	507.51	507.28	0.93259	0.0016
	Social Studies	Overall	593.48	590.64	0.04466	0.0409
		FRPL Only	588.5	585.12	0.00660	0.0554
		Non-FRPL Only	598.46	596.16	0.36755	0.0184
	Science	Overall	573.57	570.02	0.03851	0.0421
		FRPL Only	567.44	562.63	0.00149	0.0647
		Non-FRPL Only	579.70	577.40	0.45681	0.0151
Second Grade	Vocabulary	Overall	599.41	600.07	0.53051	0.0119
		FRPL Only	593.06	592.07	0.30203	0.0195
		Non-FRPL Only	605.75	608.07	0.22247	0.0231
	Word Analysis	Overall	623.52	622.96	0.54977	0.0113
		FRPL Only	617.38	615.78	0.06321	0.0352
		Non-FRPL Only	629.66	630.13	0.78454	0.0052
	Math Computation	Overall	547.82	547.64	0.87380	0.0030
		FRPL Only	542.09	539.98	0.03842	0.0391
		Non-FRPL Only	553.54	555.29	0.38214	0.0165
	Social Studies	Overall	610.25	612.44	0.04977	0.0400
		FRPL Only	604.55	602.68	0.07137	0.0367
		Non-FRPL Only	615.94	622.19	0.00155	0.0645
	Science	Overall	590.02	589.48	0.69233	0.0081
		FRPL Only	583.47	580.91	0.04169	0.0415
		Non-FRPL Only	596.57	598.05	0.53545	0.0126

C. Single-Time-Point Models

Grade Level	Assessment	Comparison	Model-Implied Adjusted Mean Scores		*p*-value	Effect Size (d)
			Pre-K	Non-Pre-K		
Second Grade	Spelling	Overall	587.84	586.51	0.36216	0.01967
		FRPL Only	580.32	577.45	0.03102	0.04655
		Non-FRPL Only	595.35	595.57	0.93559	0.00174

Appendix B

Characteristics of School Systems in Tennessee

System	Urban-Centric Locale 2005-2006 (NCES)	Median Household Income in District (2000 Census)	% of Children in Poverty in District (2000 Census)	% of Children Receiving Free or Reduced Price Lunch (NCES)	% Minority/ Non-White Students in District (NCES)	Total Expenditures per Student in District, 2005-2006 (NCES)
Alamo	Rural, outside of CBSA/MSA	$38,295	22.8	48.0	25.5	$7,692
Alcoa	Urban fringe of mid-size city	$44,333	16.4	40.8	26.7	$9,070
Alvin C York Institute	--	--	--	--	--	--
Anderson County	Urban fringe of mid-size city	$38,861	17.1	47.2	2.7	$8,076
Athens	Small Town	$39,563	20.9	43.1	22.5	$7,868
Bedford County	Rural, outside of CBSA/MSA	$40,691	15.8	45.5	23.2	$6,468
Bells	Rural, outside of CBSA/MSA	$31,827	26.9	50.7	42.8	$6,388
Benton County	Rural, outside of CBSA/MSA	$32,727	23.2	45.6	6.0	$5,535
Bledsoe County	Rural, outside of CBSA/MSA	$34,593	20.1	63.2	3.6	$7,048
Blount County	Rural, inside of CBSA/MSA	$43,933	11.9	40.0	4.0	$6,938
Bradford	Rural, outside of CBSA/MSA	$40,788	19.4	55.0	6.9	$7,003
Bradley County	Mid-size City	$42,710	11.8	59.0	4.8	$6,388
Bristol	Mid-size City	$37,341	17.3	43.4	7.5	$8,335
Campbell County	Rural, outside of CBSA/MSA	$30,197	31.5	69.0	0.9	$6,833
Cannon County	Rural, inside of CBSA/MSA	$38,424	13.4	48.2	3.3	$7,402
Carroll County	Rural, outside of CBSA/MSA	--	--	9.6	12.8	--
Carter County	Urban fringe of mid-size city	$33,913	20.5	63.0	2.0	$7,130
Cheatham County	Rural, inside of CBSA/MSA	$49,143	7.4	29.0	3.4	$6,419
Chester County	Rural, inside of CBSA/MSA	$41,127	17.3	44.6	16.5	$6,026
Claiborne County	Rural, outside of CBSA/MSA	$31,234	27.9	64.6	1.5	$7,506
Clay County	Rural, outside of CBSA/MSA	$29,784	23.3	61.9	2.6	$8,176
Cleveland	Mid-size City	$40,150	18.6	49.7	24.3	$8,047
Clinton	Urban fringe of mid-size city	$43,099	21.3	47.5	5.8	$8,287
Cocke County	Rural, outside of CBSA/MSA	$31,014	30.5	70.1	3.8	$7,288
Coffee County	Small Town	$42,258	9.6	52.9	4.3	$7,077
Crockett County	Rural, outside of CBSA/MSA	$37,511	13.6	51.7	27.1	$6,804
Cumberland County	Small Town	$35,928	19.4	52.1	3.3	$8,666
Davidson County	Large City	$49,317	18.2	57.5	63.0	$9,625
Dayton	Small Town	$33,149	20.8	54.6	16.8	$6,779
Decatur County	Rural, outside of CBSA/MSA	$34,919	18.1	44.8	8.2	$7,335
DeKalb County	Small Town	$36,920	19.6	52.2	6.0	$6,654
Dickson County	Urban fringe of large city	$45,575	12	42.8	9.7	$7,114
Dyer County	Rural, outside of CBSA/MSA	$42,406	12.6	52.6	9.7	$7,333
Dyersburg	Small Town	$34,754	27.1	55.8	35.0	$7,430
Elizabethton	Urban fringe of mid-size city	$33,333	28.7	38.8	5.2	$8,270
Etowah	Small Town	$33,034	26.4	59.0	6.1	$7,224
Fayette County	Rural, inside of CBSA/MSA	$46,283	17.4	73.2	65.4	$8,026
Fayetteville	Small Town	$32,477	27.4	37.6	29.4	$6,837

Cont'd **System**	**Urban-Centric Locale 2005-2006 (NCES)**	**Median Household Income in District (2000 Census)**	**% of Children in Poverty in District (2000 Census)**	**% of Children Receiving Free or Reduced Price Lunch (NCES)**	**% Minority/ Non-White Students in District (NCES)**	**Total Expenditures per Student in District, 2005-2006 (NCES)**
Fentress County	Rural, outside of CBSA/MSA	$28,856	27.8	67.0	0.9	$7,403
Franklin	Urban fringe of large city	$65,652	9.5	25.3	30.9	$11,265
Franklin County	Rural, outside of CBSA/MSA	$42,279	16.1	48.2	9.4	$7,229
Gibson County Special School Dist.	Rural, outside of CBSA/MSA	$40,107	11.8	37.4	10.4	$6,706
Giles County	Small Town	$41,714	13.8	46.0	16.8	$7,125
Grainger County	Rural, inside of CBSA/MSA	$33,347	23.0	56.0	1.8	$6,383
Greene County	Rural, outside of CBSA/MSA	$37,088	16.0	53.6	2.8	$6,596
Greeneville	Small Town	$36,129	27.0	33.5	12.5	$9,135
Grundy County	Rural, outside of CBSA/MSA	$27,691	30.0	67.8	0.5	$6,908
Hamblen County	Mid-size City	$39,138	18.5	49.8	16.9	$7,179
Hamilton County	Urban fringe of mid-size city	$48,037	16.0	49.9	39.4	$7,960
Hancock County	Rural, outside of CBSA/MSA	$25,372	36.3	65.3	0.8	$9,311
Hardeman County	Small Town	$34,746	23.4	71.2	56.8	$7,311
Hardin County	Rural, outside of CBSA/MSA	$34,157	26.4	55.8	7.7	$7,053
Hawkins County	Urban fringe of mid-size city	$37,696	19.2	56.6	2.6	$7,275
Haywood County	Small Town	$32,597	21.3	72.3	70.1	$7,238
Henderson County	Rural, outside of CBSA/MSA	$37,977	14.7	50.2	9.8	$6,560
Henry County	Rural, outside of CBSA/MSA	$36,555	16.5	51.7	9.6	$7,015
Hickman County	Rural, inside of CBSA/MSA	$36,342	15.2	49.9	4.5	$6,719
Hollow Rock Bruceton	Rural, outside of CBSA/MSA	$34,205	14.2	55.5	12.1	$6,513
Houston County	Rural, outside of CBSA/MSA	$35,395	22.7	46.7	7.0	$6,119
Humboldt	Small Town	$32,730	22.4	0.0	72.9	$7,037
Humphreys County	Rural, outside of CBSA/MSA	$42,129	13.0	47.0	4.1	$6,735
Huntingdon	Rural, outside of CBSA/MSA	$38,822	17.3	48.5	18.4	$7,481
Jackson County	Rural, outside of CBSA/MSA	$32,088	15.2	59.6	0.8	$6,638
Jefferson County	Rural, inside of CBSA/MSA	$38,537	16.4	50.0	5.3	$6,825
Johnson City	Mid-size City	$40,834	16.8	39.1	17.2	$8,268
Johnson County	Rural, outside of CBSA/MSA	$28,400	26.1	58.8	2.0	$8,378
Kingsport	Mid-size City	$40,038	23.5	39.8	11.1	$8,456
Knox County	Urban fringe of mid-size city	$49,182	13.7	36.0	19.3	$7,641
Lake County	Rural, outside of CBSA/MSA	$30,339	31.2	62.1	30.5	$7,840
Lauderdale County	Small Town	$36,841	23.0	68.8	44.3	$6,939
Lawrence County	Rural, outside of CBSA/MSA	$35,326	17.8	48.5	4.2	$6,658
Lebanon	Urban fringe of large city	$46,915	16.7	46.5	28.7	$7,011
Lenoir City	Urban fringe of mid-size city	$33,462	18.6	49.1	14.7	$7,674
Lewis County	Small Town	$35,972	15.5	56.1	5.3	$6,376
Lexington	Small Town	$41,429	11.3	41.7	23.4	$7,743
Lincoln County	Rural, outside of CBSA/MSA	$42,485	12.3	41.9	8.4	$6,277
Loudon County	Urban fringe of mid-size city	$49,214	9.7	41.2	8.2	$8,040
Macon County	Rural, inside of CBSA/MSA	$37,577	15.3	49.7	4.1	$6,218

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Madison County	Mid-size City	$44,595	18.0	0.0	60.1	$7,742
Manchester	Small Town	$38,404	21.7	46.4	15.9	$7,497
Marion County	Urban fringe of mid-size city	$36,614	19.1	59.0	5.8	$7,142
Marshall County	Small Town	$45,731	11.1	38.2	13.3	$6,578
Maryville	Urban fringe of mid-size city	$49,182	11.2	20.9	8.5	$8,952
Maury County	Large Town	$48,010	13.6	44.0	25.2	$7,114
McKenzie	Small Town	$38,298	14.7	49.9	14.3	$5,931
McMinn County	Rural, outside of CBSA/MSA	$39,540	14.8	47.0	7.7	$6,321
McNairy County	Rural, outside of CBSA/MSA	$36,045	19.8	51.0	9.7	$6,752
Meigs County	Rural, outside of CBSA/MSA	$34,114	23.1	61.6	1.8	$6,955
Memphis	Large City	$37,767	28.2	73.4	91.6	$8,494
Milan	Rural, outside of CBSA/MSA	$40,166	14.9	46.2	25.2	$6,746
Monroe County	Rural, outside of CBSA/MSA	$34,848	17.8	59.1	4.9	$6,512
Montgomery County	Mid-size City	$43,071	12.3	39.0	36.0	$8,185
Moore County	Rural, outside of CBSA/MSA	$41,484	13.9	40.3	2.2	$8,064
Morgan County	Rural, outside of CBSA/MSA	$31,901	16.9	58.4	1.1	$7,360
Murfreesboro	Mid-size City	$52,654	11.7	41.2	37.9	$8,495
Newport	Small Town	$26,791	35.4	43.0	10.3	$7,986
Oak Ridge	Urban fringe of mid-size city	$52,361	15.7	28.9	22.9	$10,097
Obion County	Rural, outside of CBSA/MSA	$40,449	14.7	44.7	8.0	$9,104
Oneida	Small Town	$29,786	28.7	55.7	0.8	$6,614
Overton County	Small Town	$32,156	19.1	59.3	1.0	$7,112
Paris	Small Town	$33,259	23.6	53.3	23.7	$6,827
Perry County	Rural, outside of CBSA/MSA	$34,792	16.9	53.9	4.3	$7,287
Pickett County	Rural, outside of CBSA/MSA	$31,355	19.4	61.0	0.6	$8,413
Polk County	Rural, inside of CBSA/MSA	$36,370	14.1	55.9	0.9	$7,272
Putnam County	Large Town	$39,553	15.0	42.4	9.6	$6,952
Rhea County	Rural, outside of CBSA/MSA	$36,331	18.6	53.6	5.0	$6,981
Richard City	Urban fringe of mid-size city	$29,762	26.7	46.6	5.5	$9,663
Roane County	Small Town	$43,030	18.4	47.6	5.4	$7,294
Robertson County	Rural, inside of CBSA/MSA	$49,412	11.5	35.8	16.4	$6,430
Rogersville	Urban fringe of mid-size city	$32,236	28.2	36.9	6.3	$6,555
Rutherford County	Urban fringe of large city	$53,975	6.2	30.3	24.0	$8,053
Scott County	Rural, outside of CBSA/MSA	$28,238	23.8	79.9	0.5	$7,014
Sequatchie County	Rural, inside of CBSA/MSA	$36,435	25.2	57.8	2.8	$6,911
Sevier County	Rural, outside of CBSA/MSA	$40,474	12.3	50.6	4.6	$7,451
Shelby County	Urban fringe of large city	$71,754	5.5	24.9	39.4	$7,209
Smith County	Rural, inside of CBSA/MSA	$41,645	14.3	42.0	4.8	$6,667
South Carroll	Rural, outside of CBSA/MSA	$37,134	11.0	36.6	7.3	$5,728
Stewart County	Rural, inside of CBSA/MSA	$38,655	12.6	47.7	2.9	$10,076

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Sullivan County	Urban fringe of mid-size city	$42,172	13.1	40.7	1.4	$7,098
Sumner County	Urban fringe of large city	$52,125	9.8	29.2	13.6	$6,637
Sweetwater	Rural, outside of CBSA/MSA	$35,269	26.9	63.8	15.6	$5,906
Tennessee School for Blind	--	--	--	--	--	--
Tennessee School for Deaf	--	--	--	--	--	--
Tipton County	Rural, inside of CBSA/MSA	$49,009	10.6	48.6	27.7	$6,472
Trenton	Small Town	$41,775	12.8	56.2	30.8	$6,895
Trousdale County	Rural, inside of CBSA/MSA	$37,401	12.1	45.1	11.9	$7,070
Tullahoma	Small Town	$38,210	21.3	37.2	11.6	$8,597
Unicoi County	Urban fringe of mid-size city	$36,871	16.3	49.7	5.2	$7,578
Union City	Small Town	$40,737	26.7	56.2	45.5	$7,547
Union County	Rural, inside of CBSA/MSA	$31,843	25.8	62.6	0.9	$7,722
Van Buren County	Rural, outside of CBSA/MSA	$34,949	19.1	54.4	0.3	$6,751
Warren County	Rural, outside of CBSA/MSA	$37,835	18.4	50.2	14.3	$8,185
Washington County	Rural, inside of CBSA/MSA	$41,377	15.7	43.3	3.4	$6,619
Wayne County	Rural, outside of CBSA/MSA	$30,973	19	57.0	2.5	$7,730
Weakley County	Rural, outside of CBSA/MSA	$38,658	15.9	50.0	12.0	$6,608
West Carroll Special School Dist	Rural, outside of CBSA/MSA	$36,098	21.6	56.3	11.2	$6,815
West Tennessee School for Deaf	--	--	--	--	--	--
White County	Small Town	$34,854	16.9	49.7	3.8	$6,230
Williamson County	Urban fringe of large city	$82,731	4.2	8.5	10.2	$8,656
Wilson County	Urban fringe of large city	$60,071	5.5	18.3	10.5	$7,169