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ABSTRACT

Rural development is often presumed to rest on educational improvement, and high levels of mathematics achievement might seem essential to improving the quality of rural life and the viability of rural communities. Efforts to promote math achievement growth are usually limited to curricular and instructional innovations, while contextual factors related to changing economic activity and social organization are overlooked. In contrast, this study focuses on contextual factors such as the increasing importance of social class, declining payoffs for investments in education, families' need for two incomes, widespread use of dubious-quality child care, and the fragility of nourishing institutions (extended families and neighborhoods). The math achievement growth of 305 elementary students in 6 rural and 6 nonrural schools in West Virginia were examined from kindergarten through the end of grade 3. Using a multilevel repeated-measures model, it was found that math achievement growth in this sample was contextually constrained in ways that are rarely acknowledged. Not surprisingly, maturation (time) and socioeconomic status (SES) were important influences. More surprisingly, neighborhood quality (separate from SES) positively influenced achievement growth, while a school's participation in private daycare (as opposed to Head Start) negatively influenced achievement growth, all else equal. Higher school-level SES and participation in Head Start were associated with greater achievement gains over time. Rural locale did not significantly affect achievement. (Contains 100 references) (Author/SV)

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Elementary Math Achievement for Rural Development: Effects of Contextual Factors Intrinsic to the Modern World

Working Paper No. 15

Robert Bickel and Caitlin Howley
Marshall University and AEL, Inc. and Temple University
March 2003

ACCLAIM's mission is the cultivation of *indigenous leadership capacity* for the improvement of school mathematics in rural places. The project aims to (1) understand the rural context as it pertains to learning and teaching mathematics, (2) articulate in scholarly works, including empirical research, the meaning and utility of that learning and teaching among, for, and by rural people, and (3) improve the professional development of mathematics teachers and leaders in and for rural communities.

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ELEMENTARY MATH ACHIEVEMENT FOR RURAL DEVELOPMENT: EFFECTS OF CONTEXTUAL FACTORS INTRINSIC TO THE MODERN WORLD

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Abstract

In the modern world, where development is construed as science-based and technology-intensive, enhanced math achievement growth seems essential to improving the quality of rural life and reinforcing the durability of rural communities. Typically, efforts to promote math achievement growth are limited to curricular and instructional innovations. Contextual factors intrinsic to the changing nature of national and international economic activity and social organization are commonly overlooked.

This study of elementary mathematics achievement growth focuses by contrast on contextual factors (the increasing importance of social class as a structural phenomenon, declining payoffs for investments in education, families' need for two incomes, widespread used of dubious quality day care, and the fragility of established institutions such as families and neighborhoods) related to math achievement growth of individual students from the beginning of kindergarten until the end of third grade in 12 elementary schools (six rural and six nonrural) in two county districts in a southeastern state.

Using a multilevel repeated-measures model, we conclude that math achievement growth in this sample is contextually constrained in ways that are rarely acknowledged. Not surprisingly, maturation (i.e., our time variable) yields the largest proportion of achievement growth accounted for by the model, with between-subject socioeconomic status (SES) also contributing its familiar influence. More surprisingly, we find that neighborhood quality (separate from SES) *positively* influences achievement growth, whereas a school's rate of participation in private daycare (as opposed to Head Start participation) *negatively* influences achievement growth, all else equal. In this multilevel

repeated-measures model, as well, two cross-level interactions were apparent, each between time (a level-1 variable) with a second-, or school-, level variable. First, higher school-level SES was associated with greater math achievement gains over time, and, second, the rate of a school's participation in Head Start increases the influence of time on students' mathematics achievement growth. Rural locale did not affect achievement at a statistically significant level, but we did observe the usual relationship of (smaller) school size and rurality.

We conclude that whether or not math achievement growth fosters economic development, such growth may in fact be limited by the nature of the modern world that rural development efforts seek to accommodate.

Elementary Math Achievement for Rural Development: Effects of Contextual Factors Intrinsic to the Modern World

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Introduction

Rural development in the U.S. and elsewhere is often presumed to rest on educational improvement. The presumed role of mathematics and science knowledge as a foundation of global economic competitiveness at the national level may contribute to the familiar presumption about the relationship between *rural* development and education. On this view, high levels of mathematics achievement growth might seem essential to improving the quality of rural life and reinforcing the durability of rural communities. On the basis of such presumptions, of course, typical efforts to improve mathematics learning in (or by) rural communities deploy curricular and instructional innovations. Understandably, given the prevailing presumptions about the "needs" of rural development, contextual factors intrinsic to the changing nature of national and international economic activity and social organization, changes that are evident in rural communities, are commonly overlooked. Most analyses fail completely to adopt the stance of skepticism toward such "innovations" of modernism that have come to rural communities. This study does adopt such a stance, however, by focusing attention on contextual factors (e.g., the increasing importance of social class as a structural phenomenon, declining payoffs for investments in education, families' need for two incomes, widespread used of dubious quality day care, and the fragility of established institutions such as families and neighborhoods).

At the outset, it is important to note that the taken-for-granted inferiority of rural schooling is no longer an inevitable constituent of public policy making and educational reform in the U.S. (Khattari, Riley, & Kane, 1997; Lee & McIntire, 2000; Lee, 2001). Much as with non-rural locations, it is true that the quality of rural schooling varies from place to place (Lee and McIntire, 2000). The ostensibly poor quality of rural education, however, is no longer reflexively invoked as an obvious and durable barrier to progressive social change in rural settings.

For critics of public education wherever it occurs, acknowledging that the quality of rural education matches that in non-rural areas may be an instance of damning with faint praise (cf. Berliner & Biddle, 1995). Nevertheless, much as in Third World countries, rural development in the U.S. is commonly treated as an education-intensive process (McGranahan, 2001; Beaulieu, Barfield, & Stone, 2001; Rogers, 2001; Drabenstatt & Sheaff, 2001).

For those who hold that rural residents are stubbornly old-fashioned participants in an outmoded culture of bucolic insularity, schools are places where students can be imbued with a modern mindset (Inkeles & Smith, 1974/1999; Auletta, 1982). For those who hold that rural residents have not acquired the everyday social skills needed to be effective participants in an increasingly complex world, schools are agencies of enabling socialization (West Virginia Kids Count Leadership Collaborative, 1996; Welsh, Greene, and Jenkins, 1999). And for those who maintain that rural areas often suffer from a human capital deficit, schools can provide the general education and vocational training to enable students to become self-sufficient contributors to rural economies (Woodhall, 1996; Carter, 1999; Beaulieu, 2000).

Too often, it is true, prescriptions offered for rural development, education-intensive or otherwise, read like tacit claims that a distinctively rural world is obsolete (Howley, 1997). For now, however, we shall proceed under the assumption that proponents of rural development recognize that "rural" and "backwater" are not synonyms, and frame a set of pertinent research objectives grounded in a critical account of the world we share at the beginning of the 21st century.

Research Objectives

In the following, we use multilevel repeated-measures analysis in a two-county quantitative case study set in Appalachian West Virginia. We seek to determine if rural elementary schooling, as represented in our data set, promotes growth in math achievement as effectively as non-rural elementary schooling. In doing this, we build on earlier work that sought to clarify the nature of rurality, especially rural neighborhoods and the effect of rural neighborhood quality on early math achievement gains (Bickel, Smith, & Eagle, 2002).

In addition, we seek to locate judgments about rural schooling and neighborhood quality in an informed context, identifying constituents of the modern social setting that may promote or diminish math achievement in both rural and non-rural schools. Specifically, we focus on overarching contextual factors, including the ongoing internationalization of the modern economic world and its sometimes unacknowledged local consequences. These include the increasing importance of social class background for attainments of all kinds, declining payoffs for investments in education, diminished purchasing power resulting in the need for two breadwinners in most families, the consequently heavy reliance on dubious-quality day care, and the contextually determined weakening of established institutions, including family and neighborhood. Throughout, we acknowledge that rural math education in the elementary grades may very well be a distinctive social endeavor. However, as with other educational activities, it too often is treated as autonomous of the world in which it occurs. We examine the possibility that ignoring the inevitably implicated nature of the modern world undermines efforts to understand rural math achievement growth and its consequences for rural development efforts.

Why Math Education?

Generally, the hoped-for contribution of rural schooling to rural development can best be captured in the time-honored education concept "articulation." Rural schools are at their best when they enable rural residents to fit comfortably in the modern and modernizing world. The notion of a seamless curriculum, thus, is extended to include uninterrupted transition from one level of schooling to another, as well as from school to work, and from school to effective citizenship (see, for example, EXTEND, 1996).

In this vein, policies seeking to couple rural regions to the rest of the contemporary social system often cite the science-based character of modern life. As a result, general education and vocational training in math and science in rural schools have been given added salience. The emphasis, increasingly, is on providing an up-to-date curriculum, which smoothes the transition from school to technology-intensive work, or from school to the kind of postsecondary education, which places a premium on math, science, and applied technology (Senate Committee on Labor and Human Resources, 1997; Shapiro & Varian, 1998; McCormick, 2002).

Conspicuous, well-funded examples of this math-is-fundamental approach are the rural systemic initiatives funded by the National Science Foundation. With twenty-seven sites throughout the U.S., rural systemic initiatives are intended to promote social and economic development in rural areas by tying improved education in math, science, and technology to local needs (National Science Foundation, 1997). Other reforms that give first priority to math achievement growth include development and implementation of achievement standards tailored to the modern social setting, and ever-finer delineations of developmentally appropriate math curriculum and instruction (Schultz, 2002).

Use of enhanced math achievement growth as a tool for rural development in the modern world has undeniable appeal, even if the efficacy of this approach has not been demonstrated. It is useful to point out, however, that the thin literature on rural math achievement does not suggest that rural schools do less well in fostering math achievement growth than schools in non-rural areas.

A recent analysis of National Assessment of Educational Progress data, for example, showed no overall differences in math achievement between rural and non-rural students at the national level (Howley, 2002). Instead, while most investigations indicate that rural students tend to score less well on math achievement tests than their non-rural counterparts, the difference disappears or is sharply diminished when controls for social class differences are introduced (Gau, 1997; Young, 1997, 1998a, and 1998b; Webster and Fisher, 2000; Howley, 2002). Lee and McIntire (1999), moreover, found that, when social class was controlled, rural schools' measured math achievement levels were higher than those of non-rural schools. As some see it, the level of math achievement found in rural schools is remarkably high given their comparative lack of resources (Lee and McIntire, 1999 and 2000; Schultz, 2002).

Research Objectives in Context

In addressing our research objectives concerning rural development through improved math education, we proceed from the view that the modern, largely non-rural world, has posted cautionary signs for those who would emulate its patterns of organization when promoting the development of rural settings. Rural development policy makers, understandably, focus on ways to more securely tie rural schooling to ostensive demands of the modern world. Too often, however, they manifest a good-faith but unduly narrow emphasis on instructional and curricular reforms, such as constructivism; non-traditional delivery systems, such as distance learning; or accountability mechanisms, such as performance standards and mandated testing (Gibbs and Howley, 2000). These narrowly focused efforts to accommodate the technology-intensive nature of modernity often cause us to lose sight of other, equally compelling contextual factors, representing unanticipated consequences and unkept promises in contemporary society.

The Increasing Importance of Social Class

In spite of the meritocratic pretensions of a science-based, technology-intensive modern world, social class is becoming more important as a determinant of educational, occupational, and income attainments (Wilson, 1980; Halsey & Young, 1997; Conley, 1999; Phillips, 2002). Since the passing of the era of the social contract, from 1946 until about 1973, those of high social class have enjoyed a disproportionate share of non-merit based advantages, while the life chances of the less advantaged have diminished (Brown, 1995; Brown & Lauder, 1996; Goldthorpe, 1996; Schwarz, 1997; Perrucci & Wysong, 1999). This has been acknowledged, though sometimes obliquely, even by mainstream neoclassical economists and other centrist and right-of-center social scientists (Schwarz, 1997; McMurrer & Sawhill, 1998; Phillips, 2002). Even those who caution against exaggerating the determining effects of class effectively document its pervasive, often unseen or misunderstood importance in contemporary life (Lareau, 2002).

The significance of social class is best understood if we construe class as a macro-level organizational phenomenon, as well as an ascribed characteristic of individuals. Some benefit from the way things are organized, while others do not have the resources to be effective participants (Alford & Friedland, 1986). Increasingly, social class, and its attendant effects on life chances, is globally structured (Brown, Halsey, Lauder, & Wells, 1997).

Obvious historical and contemporary developments that illustrate the organizational or structural view of class are easy to find: the capital-intensive mechanization of farming, forcing most family farms out of business (Heilbroner & Milberg, 2001); the automation of coal mining, reducing the number of working miners by more than 90% and, as with farming, undermining the inheritance of this specific occupational status and grounded identity across generations (Gaventa, 1982); factory closings which turned the "steel belt" into the "rust belt," as industrial jobs are moved to low-wage Third World countries (Higgins, 1999); down-sizing and out-sourcing as large enterprises, both private and public, cut labor costs at the expense of white collar workers and the professional middle class (Crenson & Ginsberg, 2002); de-skilling and union-busting in formerly skilled occupations, such as meatpacking (Schlosser, 2002); global auctioneering, as multi-national corporations play one nation against another to see which will come up with the best collection of tax incentives, relaxed environmental regulations, and weakened labor standards (Stiglitz, 2002).

The foregoing examples need not be interpreted as an implied condemnation of the social system that occasions them. Each, however, can be reasonably construed as an instance of social and economic development, and each suggests the increasing importance of social class as a national and global organizational phenomenon.

Family Resources and Unregulated Day Care

At the same time, payoffs for investments in education have declined, and real purchasing power for full-time employees in most kinds of work has fallen (Blau, 1993; Levin & Kelly, 1994: McMurrer & Sawhill, 1998; Ehrnereich, 2002). Prospects for the next generation are poorer than those of its parents' generation. The working class, in large measure, has become the de facto working poor (Wilson, 1996). Even middle class families, especially those with pre-school or school-age children, require two breadwinners to live more or less comfortably (Newman, 1988 and 1993; Rubin, 1994). This, it has been persuasively argued, is one of the reasons for the persistence and popularity of *A Nation at Risk*-style education-bashing: educational attainment does not pay off economically nearly so well as it once did, so there must be something wrong with our schools (see Wise, 1979, which anticipated the solutions ushered in by *Nation at*

Risk). With the material rudiments of a middle class life-style becoming increasingly difficult to obtain even for families with two incomes, day care for children has become a staple institution, serving nearly seventy percent of those aged five or under (NICHD, 2002). In the U.S., however, day care is largely unregulated, most facilities are unlicensed, and staff members are often untrained (Mack & Boehm, 2001). As a result, for more than sixty percent of its preschool customers, day care is, at best, a custodial experience (Zaslow & Trout, 2002).

Of the rural children in day care, seventy-five percent are served through informal arrangements, provided by members of the extended family or neighbors (Beach, 1997). The quality of specific families and neighborhoods varies enormously, and the quality of rural day care varies accordingly.

Because our data were collected from a rural county and non-rural county in which family incomes of parents of elementary school children were only about eleven hundred dollars a month, 62.8% of all students participated in Head Start. Nevertheless, a substantial number, 31.7%, had participated in one form or another of private day care. For these children and their families, the absence of a national day care system and lack of strict enforcement of research-based standards means that selecting a facility is fraught with uncertainty, and the odds are stacked against them (Beach, 1997).

Education-Intensive Interventions

During the past decade, proposals for educational intervention have acquired a high profile. Ever-earlier interventions, such as precursors to the venerable Head Start, are commonly proposed as means of compensating for real or imagined family deficiencies (Bickel & McDonough, 1998; Ellsworth & Ames, 1998; Bickel & Spatig, 1999; Brookings Institution, 1999).

Some states, Appalachian West Virginia among them, have begun pilot programs aimed at education-intensive intervention to assure that the children of materially impoverished parents will be able to acquire the human capital needed to escape their parents' economic circumstances (Bickel & Spatig, 1999). Whether or not such programs smack of victim blaming, the effectiveness of early intervention for promoting math achievement growth has not been demonstrated. Thirty-seven years after its inception, even the efficacy of project Head Start remains uncertain (Currie and Duncan, 1994; U.S. Government Accounting Office, 1997; Bickel & McDonough, 1998).

However, in a world where human capital theory is taken seriously, and in which we sometimes presume to know more than we do about improving students' achievement, the value of early educational intervention tends to be uncritically accepted. Nevertheless, even if the human capital-theoretic basis for such proposals were valid, it is by no means clear that we have the educational knowledge to make them work (Currie & Duncan, 1995; Bickel & McDonough, 1998; Spatig, Bickel, Parrot, Dillon, & Conrad, 1998; McNabb, 2000; Bickel, Tomasek, & Eagle, 2000; for a sharply differing view, see Henderson and Royster, 2000; Denton & West, 2002).

The Transitory Nature of Established Institutions

Finally, shifting investment patterns of large, rationally calculating economic actors, especially multinational corporations, have rendered the continued existence of each extended family, neighborhood, and community unpredictably transitory (Bickel &

McDonough, 1997; Anyon, 1997; Cummings, 1998; Heilbroner and Milberg, 2001). In world of work, in a time of the absence of a reliable economic base, obligatory lip service is paid to the value of families, neighborhoods, and communities as institutions that foster school achievement growth and a variety of other desirable outcomes. In fact, however, the jobless economic recoveries, is subject to ongoing changes that assure that traditional institutions rest on a fragile economic base. Some observers have gone so far as to judge that, in our modern world, the only sacred institution is the unregulated market (Frank, 2000).

Research in Rural Appalachia

Our earlier research offered little to disabuse us of the uncomfortable feeling that the context for using math education as a tool for rural development was unfavorable, and that it may be hostile to the distinctive character of the rural world (Bickel & McDonough, 1997 and 1998; Spatig, Bickel, Parrott, Dylan, & Conrad, 1998; Bickel & Spatig, 1999). We found that both established and exploratory early intervention efforts had no effect on rural children's achievement in math or other disciplines. When prior achievement was statistically controlled, moreover, none of a broad range of individual-level factors had a statistically significant relationship with math achievement levels at the end of the first year of school. Predictors of prior achievement itself, moreover, included the usual schools-don't-make-a-difference suspects, especially family income. This is not surprising, since our review of research on rural math achievement indicates that social class, not rural or non-rural location, is the most powerful predictor of performance. Again, class differences have acquired increased power as a cross-generational determinant of life chances.

In more recent research, however, we found an interesting school-level contextual factor, rural neighborhood quality (Bickel, Smith, & Eagle, 2002). This school-level variable had a statistically significant and positive relationship with math achievement, even with controls for prior achievement, family income, and a variety of other background factors in place. Research on neighborhood quality and school achievement is well known. Much of it has been devoted to determining if neighborhood effects exert an independent influence, or if they are simply social class effects in disguise. Our contextual effects are consistent with the emerging consensus that neighborhood effects are real, and that they persist even when a reasonable complement of social class proxies has been introduced (Vartanian & Gleason, 1999; Solon, Page, & Duncan, 2000).

Rural Neighborhoods

Research on neighborhood effects, however, has had an ironically insular urban/suburban bias. In our work, fortunately, we had the benefit of an accumulation of seven years of ethnographic research to guide measurement of rural neighborhood quality. We were, nevertheless, constrained by an existing data set that forced us to measure rural neighborhood quality by selecting items suggested by the ethnographic work from an established neighborhood quality scale developed by Furstenburg, Cook, Elder, Eccles, & Samerhoff (1999). The resulting rural neighborhood quality scale was an eleven Likert-item instrument with a computed Cronbach's Alpha of .88. All eleven items, moreover, had loadings of .552 or higher on the first component in a principal components analysis (Bickel, Smith, & Eagle, 2002: 100). The items that constitute the rural neighborhood quality scale are reported in Table 1.

Insert table 1 about here.

Conceptualizing and Measuring Rural Neighborhood Quality

Rural neighborhoods, following the ethnographic accounts and as reflected in the revised scale, are places of family-centered privacy, with neighbors who are there if you need them, even if they live several miles away. Participants in rural neighborhoods share a common culture based on a common set of life experiences rooted in everyday activities. Social order and stability are based on a shared world view, along with a willingness to informally join together in response to threats to that world. Geographical dispersion may make social encounters among neighbors less frequent than the notion "neighborhood" suggests. Nevertheless, when neighbors meet they typically respond with the kind of holistic informality characteristic of people who know they share a common outlook. Rural neighborhoods are experienced as safe and secure places, worth the inconveniences that rural life may occasion, contemporary approximations of Durkheimian mechanical solidarity.

Rural neighborhoods, of course, vary substantially in the degree to which they conform to this typification. This variability provides the basis for measuring neighborhood quality and incorporating it into statistical analyses such as that reported below.

Neighborhood: A Universal Typification

It is important to bear in mind, however, that, in contrast to the rural research just summarized, the research reported below entails a comparison of rural and non-rural schooling. If our comparison includes neighborhood effects, we also need a means of typifying and measuring the quality of non-rural neighborhoods.

When we examine the items that constitute our neighborhood scale, it seems clear that there is no urban or suburban bias. There is nothing that implies that neighborhoods consist of rows houses, side by side, on both sides of tree-lined streets. There is nothing that implies neighborhoods are located in large apartment complexes or public housing projects. This is as we intended.

At the same time, there is nothing in the scale betokening a rural bias. Neighborhoods could be made up of small clusters of houses, often occupied by members of the same extended family, with other clusters and single dwellings out of sight and out hearing range. But neighborhoods, as the scale reads, could just as well be based in non-rural settings, such as those just sketched. Where there is a shared world view rooted in lifetimes of common experiences giving rise to a reciprocity of perspectives and a sense of mutual obligation, there is neighborhood. With this rationale, we will construe and measure rural and non-rural neighborhood quality in the same way.

Yes, there are unmistakable differences between rural and non-rural neighborhoods. But neighborhood quality, as we understand it, can be measured in either setting with the same instrument.

Down-Beat Modernity as Context

The critical perspective presented above, however, emphasized the vulnerable and transitory nature of established neighborhoods, whether rural or non-rural. Economic development in our modern world often means that nurturing institutions may fall victim to changing labor markets and the shifting investment patterns of large, often international economic actors (Bickel & McDonough, 1997; Anyon, 1997; Cummings, 1998; Putnam, 2000). These are the same forces that have lent increased salience to social class differences as determinants of subsequent attainments, declining payoffs for investments in education, the need-based predominance of families in which both parents work, heavy reliance on often inadequate day care, and use of early educational interventions to fix things, even if we are mistaken as to the provenance of imperfections. What are the consequences of these over-arching contextual factors for math achievement growth as a rural development tool?

A Multilevel Repeated-Measures Analysis

In the following analysis, we seek to avoid the sanguine assumptions of uncritical proponents of rural development who emphasize exclusively improved curriculum, innovative teaching methods, more efficient delivery systems, and alternative accountability mechanisms in math education. Instead, we acknowledge that there is a good deal of uncertainty about how to make math education more effective, and how to link math achievement growth to rural development. We then build on previous work by asking if there are identifiable contextual factors, including rural/non-rural location, neighborhood quality, and the troublesome manifestations of modernity cited earlier that may play an important role in determining math achievement growth among elementary school children.

Data

Data were collected as part of a federally-funded evaluation of a pilot program designed to maintain Head Start gains over the course of the first three years of elementary school (Ramey & Ramey, 1994). All data collection instruments were mandated by the Administration for Children and Families of the Department of Health and Human Services. While the pilot program suffered from never-solved implementation problems (Bickel & Spatig, 1999), the data are useful for secondary analyses such as this one.

Twelve elementary schools were randomly selected for the evaluation, six from the eleven elementary schools in one rural county and six from the twenty-one elementary schools in a contiguous non-rural county. Data collection began in the Fall of 1992 and ended in the Spring of 1996. Information from parents was collected through home visits.

Both counties are located in western West Virginia, bordering on Ohio and Kentucky. In 2001, the rural county had a population of 42,665, spread across 566 square miles, resulting in a population density of 84.8 people per square mile. The county was 98.8% white, 70.5% of its adult residents had graduated form high school, and 11.9% had earned at least a four-year undergraduate degree. The median age was 38.5 and median family income was $32,458. The county was 76.3% rural, in a state that is 63.9% rural; the same figure for the entire U.S. was 24.8%. The county seat is the largest town, with a population of 1,128 (West Virginia County Profiles, 1997).

In 2001, the non-rural county had a population of 95,682 spread across 280 square miles, with a population density of 343.7 people per square mile. The county was 93.4% white, 80.0% of its residents had graduated from high school, and 20.9% had at least a four-year undergraduate degree. The median age was 37.5 and median family income was $37, 691. The county was 23.4% rural, a little less than the U.S. as a whole. The non-rural county is socially and economically dominated by its county seat, a town of 54,844 that is home to a medium-sized state university (West Virginia County Profiles, 1997).

Data Analysis

The multilevel repeated-measures analysis reported in Table 4 uses repeated administrations of the widely used Woodcock-Johnson 25 math problem-solving achievement test as the outcome measure (Woodcock and Johnson, 1990). Ail variables are described in Table 1, and descriptive statistics are reported in Table 2.

The test was administered to 331 elementary school students on five occasions between 1992 and 1996: the beginning of kindergarten, the end of kindergarten, the end of first grade, the end of second grade, and the end of third grade.

Insert table 2 about here.

Insert table 3 about here.

The number of test takers from the first test administration to the fifth varied as follows: 331, 331, 287, 273, and 258. Though the students in this data set are, for the most part, from non-mobile families, attrition over the four years from the beginning of kindergarten until the end of third grade resulted in a loss of 22% of the original cases.

Fortunately, the repeated-measures procedure available with SPSS 11.0 Mixed Models as used in our multilevel analysis accommodates unbalanced designs in which the number of cases per group varies and the total number of cases is not constant across all observations (SPSS, 2001). For each case, growth curves are estimated using whatever information is available, including instances in which test-takers skip one or more administrations and then return. As a result, our analysis uses 305 cases from the original 331. We deleted 26cases because of missing data on one or more independent variables.

The repeated-measures procedure also permits use of data in which the time between test administrations varies. In this instance, the first two administrations of the Woodcock-Johnson 25 were separated by two semesters, the beginning and end of kindergarten, while the three remaining administrations were each separated by a full calendar year.

Our analysis uses variables measured at three levels: within subjects for repeated-measures, between subjects, and between schools. The twelve randomly selected schools in which the 305 student subjects were located ranged in size from 107 to 474. The number of test-takers per school varied from 5 to 74.

In addition to representing 12 schools, students, at the outset, were divided among 18 classrooms. However, schools and classrooms were confounded, with seven schools having only one kindergarten class. As a result, classrooms were not used as another level.

Math Achievement Growth as a Linear Process

With a comparatively small number of test administrations, it is typically useful to assume that growth can be represented as a linear process (Singer, 1999; Raudenbush and Bryk, 2002: 163-169). In this instance, moreover, when the repeated-measures dependent variable is regressed on time in an ordinary least squares regression equation, the R^2 value of 63.7% for a linear function is larger than for any nonlinear alternatives, including quadratic and cubic functions (cf. Snijders and Bosker, 1999: 91-94; Raudenbush and Bryk, 2002: 169-182). In addition, use of selected alternatives to a linear growth model all resulted in larger values for the smaller-is-better -2 log likelihood summary measures used with multilevel analysis in SPSS 11.0 Mixed Models. With Pearson's r equal to .80 for the association between time and achievement growth, this is exactly what one would expect.

Independent Variables

With a comparatively small number of observations at the second and third levels, we have sought to be parsimoniously selective in specifying our model (Kraft and De Leeuw, 1998: 58-60). Independent variables are limited to time, to represent movement from kindergarten through the third grade; rural/non-rural location, reflecting our interest in rural math achievement growth and rural development; neighborhood quality, building on previous research concerning neighborhood effects on math achievement in rural elementary schools, and reflecting our interest in the transitory character of established institutions; three variables that were introduced in our discussion of adverse consequences of living in a modern world – social class, day care participation, and Head Start participation – and school size. Size is included because the effect of rural/non-rural location is often confounded with school size, giving typically smaller rural schools a misleading statistical advantage (Bickel and Howley, 2000).

Time (TIME1) is a first-level, within-subjects measure that corresponds to the five dates of test administration. The effect corresponding to TIME1 has a random slope. This means that the relationship between TIME1 and the repeated-measures dependent variable is permitted to vary from student to student, with the regression coefficient corresponding to TIME1 treated as function of cross-level interactions with second-level variables.

Second-level variables include family social class (SES2), neighborhood quality (HOOD2), whether or not the student attended a private day care facility (DAYCARE2), and whether or not the student attended Head Start (HEADSTART2). All second-level variables have random slopes. This means that each second-level variable is permitted to vary from school to school, and their regression coefficients are treated as functions of cross-level interactions with third-level variables.

We have emphasized that social class is best construed as a macro-level organizational phenomenon with micro-level consequences. Measuring class as a globally structured phenomenon and incorporating this construct into our statistical model, however, is not something we can accomplish. After all, the macro-level context is the same for all students and all schools in our data set. As a result, we have used principal components analysis to create a composite measure of individual-level SES. Initially, variables used in creating the composite were adult respondent's level of educational attainment, family income, and a proxy for personal wealth created using type of housing and home ownership status (Conley, 1999). All loaded heavily on the same principal component.

Including the proxy for personal wealth, however, resulted in an SES composite closely correlated with our measure of neighborhood quality. To avoid multicollinearity problems, we used just level of education and family income, each with a loading of .806 on the first principal component.

Four of the six third-level variables, SES3, HOOD3, DAYCARE3, and HEADSTART3, are second-level variables aggregated to the school level. SES3 and HOOD3 are school means computed from second-level variables, while DAYCARE3 and HEADSTART3 are school percentages. School size (SIZE3) and rural/non-rural location (RURAL3) are organizational characteristics and, therefore, inherently third-level variables. Third-level variables have non-random slopes.

The Absence of Ethnicity

Certainly, ethnicity or race, with their predictably non-meritocratic consequences, could rightly be construed as variables that demand inclusion in our brief and selective account of imperfections of the modern world. However, reflecting the composition of the population of Appalachian West Virginia, only 8.8% of the students in our analysis are non-white, and all but 3 of the 27 attend the same non-rural elementary school. As a result, ethnicity is not included.

Cross-Level Interactions

Cross-level interaction terms are a staple of multilevel modeling. They are essential in defining the mathematical character of multilevel models (Snijders and Bosker, 1999: 72-83; Angeles and Mroz, 2001), and are of substantive value as well. As an example, in our analysis, as we shall see below, TIME1 has a statistically significant and positive main effect relationship with math achievement growth, while the regression coefficient corresponding to HEADSTART2 is not statistically significant. Nevertheless, the multiplicative interaction term created from TIME1 and HEADSTART2 is statistically significant and positive, meaning that, over time, math achievement growth for students who attended Head Start increases more than for those who did not attend Head Start. Had cross-level interaction terms not been employed, we would have continued to find no Head Start effects, much as in our previous research (Bickel and McDonough, 1998; Spatig, Bickel, Parrot, Conrad, and Dillon, 1998; Bickel and Spatig, 1999). (For a cautionary observation regarding interpretation of the TIME1byHEADSTART2 interaction effect, see below.)

As product terms, cross-level interactions proliferate rapidly as the number of independent variables increases. As a result, selection of cross-level interactions to use in an analysis must be judicious (Snijders and Bosker, 1999: 77; Kraft and De Leeuw, 1998: 72-105). We have limited our analysis to those that can be created with TIME1 and a main effect at the second level or third level, and those that can be created with RURAL3 and a main effect at the second level.

Cross-level interactions created with TIME1 were included because of the importance of time as a variable in any growth model. Cross-level interactions with RURAL3 were included because of the importance of rural/non-rural location in our analysis.

Use of grand mean and group mean centering helps to avoid intractable multicollinearity problems by rendering multiplicative interaction terms orthogonal to the variables from which they were created. In the present instance, when we use all of the selected independent variables and interaction terms in an ordinary least squares multiple regression equation, collinearity diagnostics yield fifteen variance inflation factors less than 2.00, with the others ranging from 2.60 to 3.75. The value of the condition index is 4.09. All measures are well within acceptable limits (Chatterjee, Hadi, & Price, 2000: 238-241; Kmenta, 1997: 438-439).

Efforts to include same-level interactions created using pairs of variables from level three, specifically HOOD3byRURAL3 and HOOD3byDAYCARE3, proved to be ill-advised. Even with grand mean centering, including one or both of these interaction terms yielded variance inflation factors larger than 10.00 and condition indices larger than 20.00 (see Gujarati, 2002: 352-363).

Results: Within Subjects

In Table 4 we see that TIME1, the first-level (between-subjects) independent variable with a random coefficient, is statistically significant and positive. Since we are estimating a linear growth model, this comes as no surprise. Since TIME1 has five levels, coded 0 through 4, the regression coefficient tells us that the passage of time from one test administration to another results in an increase in math achievement as measured by the Woodcock-Johnson 25 equal, on the average, to 4.14 points. Since the repeated-measures dependent variable has a mean of 23.19 and a standard deviation of 7.36, this is substantial growth.

Insert table 4 about here.

Furthermore, in Table 5 we see that from the empty model to a model with TIME1 as the only main effect, the smaller-is-better -2 log likelihood statistic decreases sharply. Using the empty model as a point of departure, the value of the summary statistic R^2_L attributable to TIME1 is 18.4% (Menard, 2002: 20-41). This is just over two-thirds of the total amount of variability eventually explained by the full model.

The R^2_L summary measure is commonly used with logistic regression, but to the best of our knowledge it has not been used with multilevel models. Simplicity and interpretability are its primary virtues: the -2 log likelihood statistic for a model with one or more explanatory variables is divided by the -2 log likelihood statistic for the empty model, with the result subtracted from one and expressed as a percentage. As such, R^2_L is the proportional reduction in the -2 log likelihood statistic due to the independent variables (Menard, 2002: 24). This measure is clearly analogous to the conventional R^2 measure, making it more intuitively appealing than measures such as Akaike's Information Criterion or Schwarz's Bayesian Criterion. The R^2_L measure is not, however, sensitive to the number of degrees of freedom used in obtaining a specified level of fit.

Tests of significance for goodness of fit differences between models are done with the -2 log likelihood statistic itself, distributed as Chi-squared. Since these tests are most reliable with maximum likelihood rather than restricted maximum likelihood estimators, we have used the former in estimating summary statistics and regression coefficients (Snijders & Bosker, 1999: 82-83.) The coefficients differ very little from one estimation method to another, and their tests of significance lead to the same decisions.

Insert table 5 about here.

Results: Between Subjects

Only one of the second-level, between-individuals independent variables, SES2, has a statistically significant regression coefficient. In this instance, for each increment in our social class composite, measured math achievement growth increases by 0.59 points. Moreover, by including second-level variables with random slopes in the equation, the R^2_L summary statistic increases to 24.9%, an increase of 6.5 percentage points.

Results: Between Schools

At the third level, between schools, there are two aggregated variables with statistically significant regression coefficients: HOOD3 and DAYCARE3. The positive relationship between the HOOD3 aggregated variable and our math achievement growth dependent variable is consistent with our earlier findings with regard to the importance of school-level neighborhood quality for early school achievement (Bickel, Smith, and

Eagle, 2002). Since the relationship holds even with SES2 and SES3 in the model, we see that neighborhood quality is unlikely to be merely a proxy for social class. Instead, at the school level, neighborhood quality has an independent effect on the growth of elementary school students' math achievement: for every one unit increment in the aggregated neighborhood quality scale score, math achievement growth increases, on average, by 0.24 points.

In view of these results and the way we have conceptualized and measured neighborhood quality, it seems reasonable to think in terms of elementary school students who live in neighborhoods that are sources of varying levels of safety, stability, and social cohesion. To a greater or lesser degree, neighbors are socially accessible and supportive. Students bring to school the ethos pervading their neighborhoods and effectively reproduce it within school settings. A high-quality neighborhood provides the social and cultural wherewithal for learning to occur. Insofar a neighborhood quality is diminished, learning is diminished as well.

The DAYCARE3 aggregated school-level variable has a statistically significant and negative relationship. This means that elementary school students' math achievement diminishes as the percentage who attended private day care increases. For every one percent increase in day care participation, math achievement growth is diminished, on average, by 3.54 points. Given the unregulated nature and often poor quality of private day care arrangements, this finding suggests that the climate for learning that prevails in an elementary school is adversely affected as the percentage of day care participants increases.

Research on day care participation among pre-school children makes a sharp distinction between licensed day care centers with certified teachers and less formal, unregulated, unlicensed home-based day care. The former, at their best, promote language and general cognitive development, and the development of social skills along with an appreciation of cooperation. Smaller, home-based facilities, staffed by one or a few untrained providers of primarily custodial care, have just the opposite effect. They undercut language and general cognitive development, and have been linked to the genesis of fearfully aggressive social responses, antithetical to cooperation (NICHD, 2002). Since, as we have noted, most day care participants in our data set attended home-based facilities of uncertain or poor quality, it is not surprising that an abundance of day care participants may undercut elementary school students' math achievement growth (Colker&Dewees, 2000).

It is true that variability in the percentage of students who attended Head Start (HEADSTART3) was not associated with elementary school students' growth in math achievement. Nevertheless, in contrast to private day care facilities, the HEADSTART3 aggregate was not linked to diminished achievement growth. Head Start seems clearly preferable to day care facilities most often used by the students in our data set.

The between-schools RURAL3 variable does not correspond to a statistically significant regression coefficient. If there were substantive or theoretical justification for using a one-tailed test, the coefficient would be significant. While rural schools are no longer reflexively regarded as inferior to non-rural schools, however, there is no basis for anticipating that they will be superior. As a result, a one-tailed test was not used.

It is also true that when the between-schools SIZE3 variable is not included in the equation, the RURAL3 coefficient is statistically significant. This is because SIZE3 is negatively correlated with RURAL3 ($r = -.245$). Inclusion of SIZE3, however, seems necessary to guard against over-valuing rural schooling when compared with non-rural schooling. Failure to control for school size has been offered as one reason why private schools, which are typically smaller than their public counterparts, are sometimes found to be more effective than public schools (Sander, 1997). Similarly, Lee and McIntire (1999), in their research on rural and non-rural math achievement, suggest that many of the benefits associated with rural schooling originate from identifiable organizational advantages, including small size, collective support, and sympathetic climate.

Results: Cross-Level Interactions

Two cross-level interaction terms, TIME1bySES2 and TIME1byHEADSTART2 have statistically significant regression coefficients. This means that, in addition to the positive main effect relationship due to social class differences at the between-subjects level, it is also the case that students from comparatively advantaged social class backgrounds benefit more from time in school than do those who are less advantaged. Similarly, while HEADSTART2 does not have a statistically significant main effect, the statistically significant coefficient corresponding to the cross-level interaction term TIME1byHEADSTART2 shows us that Head Start participation enhances the value of time spent in school as a correlate of math achievement.

Insert table 6 about here.

Results with the cross-level interactions, while interesting, should be interpreted with caution. The 11.9 point increase in the -2 log likelihood statistic was obtained using an additional ten degrees of freedom, and corresponds to a statistically non-significant Chi-squared value. Uncertainty with regard to interpretation of the statistically significant cross-level interactions is highlighted by the very small increase in the R^2_L statistic. (See Table 5.)

<u>Results: Random Coefficient Parameters</u>

When the analysis is run with just first and second level random slopes, the variance of the level 1 intercept and the variance of the slopes corresponding to TIME1, SES2, HOOD2, and HEAD2 are statistically significant. In Table 7, however, we see that when all third-level variables and all specified cross-level interactions are included in the analysis, none of the variances of the random coefficients, including the level 1 intercept, is statistically significant. This means that variability in random coefficients has been accounted for by higher level factors and cross-level interactions.

Insert table 7 about here.

One response to this set of circumstances is to change all random coefficients to fixed coefficients. Doing so, however, increases the final smaller-is-better -2 log likelihood statistic by just over 21%, reducing the final R^2_L value to 20.6% instead of 26.2%. Clearly, the random coefficients play an important role in the analysis.

First-Level Error Covariance Structure

With repeated-measures analyses, the Mixed Models procedure for SPSS 11.0 provides a range of choices for the repeated-measure error structure, including scaled identity, compound symmetry, first-order autocorrelation, variance components, and unstructured. The variances of the five scores which make up the linear growth measure varied as follows: 18.39, 15.59, 17.94, 23.00, and 54.01. As a result, we selected variance components (Schineller, 1997). Running the analysis with the alternatives yielded smaller-is-better -2 log likelihood statistics larger than that obtained with variance components (see Angeles and Mroz, 2001). Table 7 shows us, moreover, that all the repeated-measures covariance parameter estimates are statistically significant.

Discussion

It has not been our intention to make a case for or against investment in math education as an approach to rural development. We have, however, sought to place such an effort in context. In doing so, we have found that, contrary to the prevailing myth of meritocracy, social class matters, especially when class is construed as an organizational or structural phenomenon. Next to time, class is the most powerful predictor of growth in early math achievement. Social class matters, moreover, not in the benign, rise-to-the-level-of-the-advantaged-group sense made famous by the first Coleman Report (Coleman, J., Campbell, E., Hobson, C., McPartland, J., Mood, A., Weinfeld, F., and York, R., 1966), but as something that distributes costs and benefits in a fundamentally arbitrary fashion. Independent of local context, and controlling for a variety of other factors, social class advantages and disadvantages are quite real, even in the early elementary grades.

Surely, whatever the meritocratic pretensions of the modern world, social class advantages and disadvantages surprise no one. Math achievement growth advantages and disadvantages associated with being in a context influenced by varying percentages of children who have attended private day care, however, may be surprising, indeed. Nationally, most children attend day care. In our data set, as the percentage in an elementary school who have attended private day care increases, math achievement growth is diminished. (In bivariate analysis, there is no difference by rate of daycare participation in achievement *level* either at the individual or school level.) Since there is no reason to expect that day care use will decline in a time when even two-income families have difficulty making ends meet, there is no reason to expect that the aggregate achievement costs of day care will decline.

One hopeful finding concerns neighborhood quality. Whether in rural or non-rural schools, as neighborhood quality at the school level increases, measured math achievement increases, as well. This is consistent with our findings in earlier research, which focused on achievement in rural schools. Neighborhood quality and the advantages it brings may, however, prove difficult to maintain in a context marked by long-term economic uncertainty, diminished payoffs for investments in education, declining purchasing power, and transitory institutional arrangements. If such conditions form the context for rural development efforts, the contributing role of education may well *not* be instrumental.

So What?

In response to the foregoing, dutifully critical observers may understandably question the generalizability of our results. A group of 305 children selected from 12 elementary schools in two counties in western West Virginia seem unlikely to typify much more than the distinctively Appalachian area in which they are located.

It is important to bear in mind, however, that the context that gives meaning and statistical efficacy to our research is increasingly global. While there is no sound statistical basis for making inferences from our data set beyond the two counties from which it was selected, there does seem to be a solid ***substantive*** basis. This substantive basis inheres in encroaching global modernity, including its imperfections. If globally engendered contextual factors limit the effectiveness of investment in math education as a specific human capital theoretic policy for rural development in ways that we have identified in our two West Virginia counties, it seems likely that the same constraints exist elsewhere. In short, this case study may well have implications for similar locales and, more generally, for theorizing the process of global modernity.

Conclusion

Rural elementary schools, in our research, do as well as non-rural schools in promoting math achievement growth from kindergarten through the third grade. Whether or not this bodes well for efforts to promote the development of rural areas is a question we cannot answer. We have, however, placed math achievement growth in contemporary context, and, viewed in this way, promoting math achievement seems, in good part, a contextually determined activity. Even if we make an intelligent, informed, good-faith effort to foster curricular reforms, improved teacher training and teaching methods, more efficient delivery systems, and alternative accountability mechanisms, the effect on rural math achievement growth may be insubstantial. Education in math and a variety of other disciplines is valuable for a broad range of reasons, but education and its payoffs must be understood in context. The context, moreover, is becoming global, and increasingly hostile to both rural and non-rural people.

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TABLE 1

Rural Neighborhood Quality Scale Likert Items

Strongly Agree	Agree	Neither	Disagree	Strongly Disagree
1	2	3	4	5

Item 1. Your neighbors often ask too much of you.

Item 2. People around here are more willing to ask for help than to give it.

Item 3. If you are too friendly with your neighbors, people take advantage of you.

Item 4. People in this neighborhood gossip too much about each other.

Item 5. Your family would be better off if your neighbors stuck more to their own business.

Very Likely	Unlikely	Likely	Very Unlikely
4	3	2	1

How likely is it somebody would do something if …

Item 6. … someone was breaking into your house in plain sight?

Item 7. … someone was trying to sell drugs in plain sight?

Item 8. … there was a fight in front of your house and someone was being beaten?

Item 9. … your kids are getting into trouble?

Better Than Other Neighborhoods	About the Same	Worse Than Other Neighborhoods
3	2	1

Is your neighborhood …

Item 10. … safer than most neighborhoods?

Item 11. … a better place to live?

TABLE 2

VARIABLES

W-J 25	**Woodcock-Johnson 25: Applied Problem Solving Achievement and Quantitative Ability; Split-Half Reliability = .84.**
TIME	Test Administered Five Times: Beginning of Kindergarten, End of Kindergarten, End of Grade 1, End of Grade 2, and End of Grade 3.
SES2	Socioeconomic Status Composite Level 2, Between Subjects: Factor Scores from Principal Components Analysis of Annual Family Income and Adult Respondent's Level of Education.
SES3	Socioeconomic Status Composite (Aggregated) Level 3, Between Schools.
HOOD2	Neighborhood Quality Scale Score Level 2, Between Subjects. Eleven Items Adapted from Furstenburg, Elder, Eccles, and Samerhoff, 1999. Cronbach's Alpha = .88.
HOOD3	Neighborhood Quality Scale Score (Aggregated) Level 3, Between Schools.
DAYCARE2	Pre-School Day Participation Level 2, Between Subjects, Coded 1 if Child Attended Day Care and 0 Otherwise.
DAYCARE3	Pre-School Day Participation (Aggregated) Level 3, Between Schools.
HEADSTART2	Pre-School Head Start Participation Level 2, Between Subjects, Coded 1 if Attended Head Start and 0 Otherwise.
HEADSTART3	Pre-School Head Start Participation (Aggregated) Level 3, Between Schools.
RURAL3	Rural or Non-Rural School Level 3, Between Schools, Coded 1 if Rural and 0 Otherwise.
SIZE3	Total School Enrollment Level 3, Between Schools.

TABLE 3

DESCRIPTIVE STATISTICS

	RURAL		NONRURAL	
	Means	Standard Deviations	Means	Standard Deviations
W-J 25	**23.20**	**7.42**	**23.39**	**8.53**
TIME	2.00	1.42	2.00	1.41
SES2	-0.03	0.92	0.02	1.05
SES3	-0.03	0.27	0.02	0.40
HOOD2	35.66	6.78	34.35	7.62
HOOD3	35.71	2.69	34.44	2.61
DAYCARE2	0.24	0.43	0.37	0.50
DAYCARE3	0.24	0.16	0.37	0.14
HEADSTART2	0.67	0.47	0.59	0.49
HEADSTART3	0.67	0.20	0.60	0.15
SIZE3	219.67	134.39	260.51	145.27

TABLE 4

MAIN EFFECTS

LEVEL 1: WITHIN STUDENTS

PARAMETER	ESTIMATE	t VALUE	SIG. LEVEL
TIME1	**4.14**	**70.11**	**.000**

LEVEL 2: BETWEEN STUDENTS

PARAMETER	ESTIMATE	t VALUE	SIG. LEVEL
SES2	**0.59**	**2.61**	**.010**
HOOD2	0.06	1.91	.057
DAYCARE2	0.50	1.16	.247
HEADSTART2	-0.55	-1.18	.240

LEVEL 3: BETWEEN SCHOOLS

SES3	-0.39	-0.39	.699
HOOD3	**0.24**	**2.13**	**.034**
DAYCARE3	**-3.54**	**-2.01**	**.045**
HEADSTART3	1.11	0.61	.545
RURAL3	0.75	1.74	.083
SIZE3	-0.02	-0.85	.398

LEVEL 1: INTERCEPT TERM

PARAMETER	ESTIMATE	t VALUE	SIG. LEVEL
INTERCEPT	**23.13**	**126.04**	**.000**

TABLE 5

Empty Model with Random Intercept
Variance Components Error Structure

-2 Log Likelihood	9778.5

Level 1 with Random Intercept and Level 1 Random Slope
Variance Components Error Structure

-2 Log Likelihood	7976.8

$R^2_L = 18.4\%$

Level 2 with Random Intercept, Level 1 Random Slope, Level 2 Random Slopes
Variance Components Error Structure

-2 Log Likelihood	7337.0

$\mathbf{R^2_L = 24.9\%}$

Level 3 with Random Intercept, Level 1 Random Slope, Level 2 Random Slopes
Variance Components Error Structure

-2 Log Likelihood	7219.0

$R^2_L = 26.2\%$

Complete Model
Variance Components Error Structure

-2 Log Likelihood	7200.9

$R^2_L = 26.4\%\%$

TABLE 6

CROSS-LEVEL INTERACTIONS

TIME1 by LEVEL 2 PREDICTORS

PARAMETER	ESTIMATE	t VALUE	SIG. LEVEL
TIME1bySES2	**0.15**	**2.25**	**.027**
TIME1by HOOD2	-0.05	-1.19	.235
TIME1by DAYCARE2	-0.01	-0.05	.964
TIME1by HEADSTART2	**0.36**	**2.52**	**.013**

CROSS-LEVEL INTERACTIONS

TIME1 by LEVEL 3 PREDICTORS

PARAMETER	ESTIMATE	t VALUE	SIG. LEVEL
TIME1by RURAL3	-0.18	-1.47	.145
TIME1bySIZE3	0.03	0.68	.947

CROSS-LEVEL INTERACTIONS

RURAL3 BY LEVEL 2 PREDICTORS

PARAMETER	ESTIMATE	t VALUE	SIG. LEVEL
RURAL3bySES2	-0.17	-0.04	.716
RURAL3byHOOD2	-0.08	-1.29	.198
RURAL3by DAYCARE2	1.46	1.63	.105
RURAL3by HEADSTART2	0.70	0.72	.475

TABLE 7

COVARIANCE PARAMETERS: RANDOM EFFECTS

PARAMETER	ESTIMATE	WALD Z	SIG. LEVEL
Intercept	5.00	1.91	.057
HOOD2	0.00	0.00	.999
TIME1	0.14	1.88	.060
SES2	0.03	0.45	.964
DAYCARE2	0.26	0.68	.946
HEADSTART2	13.71	1.75	.079

Intraclass Correlation, Levels1&2 = .050 Intraclass Correlation, Levels 2&3 = .034

COVARIANCE PARAMETERS: REPEATED MEASURES

PARAMETER	ESTIMATE	WALD Z	SIG. LEVEL
BEGIN K'GARTEN	**9.47**	**8.35**	**.000**
END K'GARTEN	**9.62**	**9.55**	**.000**
END GRADE 1	**6.15**	**8.77**	**.000**
END GRADE 2	**11.70**	**9.43**	**.000**
END GRADE 3	**5.07**	**5.38**	**.000**

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