

Tracking Adult Literacy and Numeracy Skills

Findings from Longitudinal Research

**Edited by Stephen Reder
and John Bynner**

Tracking Adult Literacy and Numeracy Skills

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Introduction

The Need for Longitudinal Studies in Adult Literacy and Numeracy Education

Stephen Reder and John Bynner

INTRODUCTION

Understanding the origins of poor literacy and numeracy skills in adulthood and their consequences for individuals in adult life is of increasing importance in modern industrialized societies where an ever higher premium is placed on proficiency in these basic skills. The origins of this concern lie in the technological transformation of employment and globalizing pressures, which have been a dominant feature of their economies since the 1970s. For this reason there have been major initiatives in all societies to raise skills levels for which the basic skills of literacy and numeracy supply the foundations.

Countries differ in the prevalence of these problems, with English-speaking nations, especially those in North America and the United Kingdom, having particularly high proportions of their adult populations with poor literacy and numeracy skills. Such poor skills may not only be a challenge for the individual in functioning effectively in adult life but are also seen as constituting a major economic cost in terms of lost productivity and international competitiveness. Apart from their national economic consequences, low levels of skills may frequently lead to marginalization of individuals in the modern labor market and society more widely, bringing about low levels of civic participation, high costs in terms of state benefits, and various forms of “social exclusion” as manifested in drugs, crime, and poor physical and mental health.

This book examines these issues, bringing together the results of longitudinal studies carried out in North America and the United Kingdom that greatly extend our understanding of them. The chapters authored by leading experts in the field increase focus on “what works” in raising skills levels and what the social and economic returns—private and public—are to skill improvement.

RESEARCH STRATEGY

Many fundamental research questions in adult education involve change over time:

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- how adults learn
- how participation in programs influences adults' acquisition of knowledge and skills
- how adults' educational development interacts with their social and economic performance
- how adults' private and social situation in the family and community may enhance or obstruct their progress in learning

Much of the contextual aspect of adults' skill acquisition reflects a history of disadvantage extending back to early childhood, a history that may also be compounded, particularly in the case of immigrants, by the challenges of mastering a second language. The main point to emphasize is that adults with poor skills are not a homogenous population, but show considerable diversity in the features of their lives and in their past experiences and achievements. Some research has been conducted on all these aspects of skills acquisition using one-off descriptive surveys or as studies deploying the research tools of social biographical enquiry and ethnography.

Longitudinal studies can add methodological rigor and analytic tools for investigating changes in individuals, measuring changes over time in representative samples of a defined population. These supply meaningful profiles of a population and changes in it over time that can reveal aspects of likely causal processes. For example, the role of educational experience set against that of family and community life may point to particular features of learning careers that underpin success or failure. The representative sample offers opportunities for generalization from individuals to groups and the wider population of which they are members. These notions can point to changes in education provision and support provided to learners that can be hypothesized to rectify past problems and prevent their repetition in the next generation. Longitudinal research that is more qualitatively oriented in the sense of analyzing biographies of "individuals in context" can amplify the picture in complementary fashion through revealing the kinds of processes in individual lives that steer educational pathways in one direction or another.

Sometimes the longitudinal data in adult educational research take the form of a series of cross-sectional snapshots taken at different historical moments, as in some of the national and international literacy surveys that have been repeated every five or ten years. Such "continuous" surveys form a "time series" that provides the means for monitoring changes in the population as a whole. The complementary longitudinal survey of individuals can supply a basis for causal inference. Such studies may involve samples of populations of all ages, such as in the household or family *panel study*, or of groups of learners of a particular age—children, young people, adults—who form the sample for investigation. Another version is the birth cohort study that follows individuals over an extended period of their lives beginning at birth. These latter kinds of study involve data collection often

at extended intervals updating the individual life record on each new occasion. Other studies investigating, for example, progression in response to educational provision will monitor the individuals through interview and assessment fairly frequently so that relatively small elements of incremental achievement can be observed. The end product of all such studies will be some form of longitudinal data set that supplies information in the form of measures taken of a sample of the same individuals from a specified population at different times.

Although there is a growing number of longitudinal studies in adult basic education that have been completed or are in progress, or of individuals in general population samples whose educational achievement has been recorded, no systematic compilation of findings and methods has yet to be undertaken. The book helps to bridge this gap, bringing together findings from a variety of longitudinal studies that were originally presented in a conference at the National Academy of Sciences Conference Center in Woods Hole, Massachusetts. The focus of the conference was principally on research designs and methods from a comparative perspective drawing on studies, many of which were ongoing. The book's chapters move the focus to research findings and include some additional chapters from authors not at Woods Hole but whose longitudinal research is essential to the topics covered in the book. Many authors conducted the research through the auspices of the major U.S. and UK research centers with which they were affiliated—in the United States the National Center for the Study of Adult Learning and Literacy (NCSALL) and in England, the National Research and Development Centre for Adult Literacy and Numeracy (NRDC). The Woods Hole conference was jointly organized by the two centers.

The research reported embraces a range of methodological approaches from quantitative (statistical modeling) to qualitative (biographical) investigations. Others draw on administrative records as core sources of longitudinal data. One UK study uses experimental methodology to assess the effectiveness of a program with the aim of establishing unequivocally cause and effect. Triangulating findings from different methodological perspectives and research designs and across countries produces convergence on key conclusions on the role of basic skills in the modern life course and the most effective ways of enhancing them. The organization of the book is structured to reflect the wide range of perspectives and findings bearing on a number of key topics: literacy and numeracy skills, classroom and teacher studies, program impact, social and economic outcomes, the influence of family and community contexts on individually measured change.

THE MACRO CONTEXT

Although the main focus of the research reported is on individuals' needs for basic skills in the context of their everyday lives and their response to

programs directed at enhancing those skills, the wider context of these needs supplies an important backcloth to understanding them. This is particularly the case in relation to employment but also relates directly or indirectly to many aspects of family and community life. The growth of IT-based service industry at the expense of manufacturing and the decline of heavy industry and unskilled manufacturing work have had the effect of restructuring the work force with a major shift towards “white-collar” and computer-based employment. Much of the effects of these changes began in the 1970s, reaching a peak in the early 1980s, when a worldwide recession added to the pressure on jobs. The outcome was a new employment structure that increasingly demanded literacy, numeracy, and IT skills of its employees and, particularly in the case of the United Kingdom, certified skills and qualifications. The consequence was large numbers of young people finding difficulty in gaining employment and many adults losing the employment that they had.

The counterpart of these processes is *globalization*, where investment moves cross-nationally to wherever the skills sought can be matched at lowest cost and increasing pressures are placed on local industries and communities (Ashton & Green, 1996; Rifkin, 1995). Overall, the effect is increasing polarization of the labor force, in which opportunities and good prospects are available to those who have the resources to take advantage of them. At the same time, marginalized employment in the form of casual jobs and spells out of the labor force occur and especially for women having and caring for children, become the main prospects for many. In this scenario, basic skills are increasingly recognized as having high priority for individuals and for societies as a whole, because without them educational prospects and life chances more generally can be severely curtailed.

Thus, the world in which every adult, depending on the state of the local economy, could expect to move relatively effortlessly from school into some kind of stable job now becomes more problematic with numeracy and literacy as prerequisites for employment. The consequent pressure for upskilling impacts on every area of people’s lives, where written competence in reading, writing, and arithmetic are taken for granted in diverse areas, ranging from understanding regulations and instructions to filling in tax forms. Thus, although much of the focus of the research reported in this book is on individual lives, basic skills performance, and outcomes, this needs to be set against the wider set of social and economic trends occurring worldwide in which the premium placed on these forms of competence and capability is increasingly raised.

INTERNATIONAL DIFFERENCES IN EDUCATION SYSTEMS AND TERMINOLOGY

Although awareness of the need to raise literacy and numeracy levels under modern conditions has existed at least since the 1960s, one of the major

drivers of current concerns was the International Adult Literacy Survey (IALS), which was modeled after the National Adult Literacy Survey (NALS) first conducted in the United States in 1992. The IALS was carried out by Statistics Canada on behalf of the Organisation for Economic Co-operation and Development (OECD) between 1994 and 1998 on a representative sample of adults aged between sixteen and sixty-five in fourteen countries (Murray et al., 1998). IALS showed marked differences on a standardized assessment of three dimensions of literacy ("prose," "document," "quantitative") among countries, with English-speaking countries faring particularly badly, especially the United States and the United Kingdom. The term *quantitative literacy*, employed by Statistics Canada, is not in common use in the United Kingdom, where "numeracy," perceived as a quite different attribute from literacy, tends to be preferred.

The IALS graded population samples in the participating countries in terms of four literacy levels. This revealed such differences as 7 percent of the adult population performing at the lowest level of prose literacy (Level 1) in Sweden compared with over 20 percent in the United Kingdom and the United States. Such differences can be interpreted in a number of ways. Perhaps the English language has complexities that make it particularly susceptible to poor performance among substantial numbers who have, for example, missed out on part of their earlier education. Another explanation relates to the education system itself, suggesting that those countries with relatively small numbers at the lowest performance levels, such as the Nordic countries, supply their students with a much better grounding in the basic skills, which pays off throughout the whole of their educational careers. Another explanation relates to differentiation in the societies themselves, with larger proportions in such countries as the United States and the United Kingdom engaged in unskilled casual work to which poor basic skills are not an impediment or growing up in families in which less transmission of good basic skills from parents to children tends to occur. In countries such as England, the problem is compounded through an education system that implicitly accepts that a substantial proportion of children will "fail." Scotland, on the other hand, adopts a more flexible and community-based approach, keeping opportunities open for longer, through modularized assessment, which may account for its slightly higher proficiency level (Bynner & Parsons, 2006)

The various studies reported in this book are limited to North America and Great Britain, with the exception of one chapter that encompassed the wider sphere of OECD countries. Our main focus, however, is on differences and similarities in the identified role of basic skills in the life course in the United Kingdom and the United States and what, if anything, in educational experience, makes a difference.

Such extensive examination of basic skills in just two industrialized countries sharing a common language can reveal both communalities in skills building in different societal contexts while also pointing to particular

features of contrasting educational systems that work for or against skill acquisition. The U.S. education system is comprehensive in the sense that every family expects their child to enter kindergarten at the age of five and elementary school at the age of six, moving through the twelve grades of education, from elementary school to secondary school (high school), with graduation after grade 12, for the majority of students at age eighteen. Post-eighteen, equipped with a high school diploma, young people are encouraged to move into two- and four-year college and university degrees. Others leave education to enter the labor market, often before graduating from the stage they are at.

For a large number of young people who fail to graduate from high school, however, there are major obstacles to progression in the labor market and a consequent desire among a large proportion of those who drop out to return to “school” at some stage in their lives. A major opportunity for adults to do this comes through passing the General Education Development (GED) tests, preparation for which is offered through various Adult Basic Education and Adult Secondary Education courses operated by public schools, community colleges, and other agencies. The GED has historically functioned as the equivalent of high school graduation—though as one of our chapters shows, its equivalence in terms of labor market value may be questionable. Nevertheless, the GED provides a focus for adult education in the United States. Immigrants can also use this route to improve their prospects in the labor market and to gain access to higher education. In fact, the majority of those engaged in adult education classes in the United States as reported in the book were doing so for this reason.

Adult education (literacy, numeracy, and ESOL) programs in the United States are currently funded by a combination of federal and state programs. Federal support is provided under the Workforce Investment Act (WIA) of 1998, which coordinates federal programs for job training, vocational rehabilitation, and adult education and literacy. The Adult Education and Family Literacy Act (AEFLA), also known as Title II of WIA, authorizes federal appropriations to the states based on formulas involving the educational characteristics of their populations. States must match these federal funds with funds of their own to operate adult literacy and numeracy classes. A National Reporting System has been established under WIA that requires the states to collect and report data from local programs about participants’ skill levels and improvements. The standards put into place by national policy and legislation here are thus specified as system *outputs*. Programs and states are accountable for the numbers of students served and their skill gains. There are no national *input* standards for the system, such as would occur if there were national curriculum or teacher-qualification standards within the adult-education system.

The situation in the United Kingdom could hardly be more different. Unlike the standard route to high school graduation through passing grade 12 of the general U.S. educational system, in the United Kingdom (but with

significant variation between England and Wales, as opposed to Scotland) the equivalent to graduation are the school-leaving examinations, which are taken at 16, to gain the General Certificate of Secondary Education (GCSE). (We note in the United States a recent trend towards requiring students to pass state-specific competency examinations in order to obtain a standard high school diploma.) Even before this age, at thirteen to fourteen, young people will be directed into different curricula based on their prospects of achieving the goal of further progression in education, requiring a minimum of five GCSEs, from any number up to eight or nine, at grade A–C (the full range of grades is A–F)—designated in the *National Qualifications Framework* as “Level 2.” Those who succeed in gaining five GCSE’s at grade A–C are likely to continue onto the upper stage of secondary education (the “sixth form”), or to enter “Further Education colleges” or “Sixth Form colleges” devoted exclusively either to the higher level university entry-level qualification, A Level, or if on the alternative “vocational” route, to gain vocational qualifications with a view to entry into a skilled job.

The expectation is that those who succeed in A Levels (a minimum of two achieved) and those that do exceptionally well in vocational qualifications at the equivalent level (Level 3) will have the option to continue onto higher education to take a three-year university degree. In labor market terms, the degree carries particular value for earnings returns across the life course, although the lower level qualification ‘A Levels’ will also produce returns. Vocational qualifications below Level 3 are of somewhat mixed value depending on which occupational route the young person is on.

For those who leave school at sixteen and do not enter college to take full-time courses, other options available are apprenticeship, which involves employment coupled with one or two days a week doing vocational education, usually in a college. Those who do not want to register for the two-year apprenticeship, which is itself stratified between a general one-year and advanced one-year, may succeed in getting a job where training is offered by an employer or take part in a government training scheme. The others are likely to drift into casual unskilled work with periods out of the labor market altogether. Such young people constitute the problem category of much concern in British educational policy circles, young people not in education, employment and training for six months or more from the age of sixteen to eighteen (NEET).

A common feature of young people who leave the education system early at sixteen, entering casual unskilled work or leaving the labor market early (often in the case of young women, to start a family), is poor basic skills. In the light of evidence, especially from the IALS survey and a series of studies conducted for the government-established Basic Skills Agency, when the new Labour government won office in 1997, one of its early priorities was to reduce the number of adults with poor basic skills. A government committee was established under the chairmanship of Lord Moser to review the problem and suggest solutions (DfEE, 1999). The consequence two years

later was the initiation of a major government initiative to raise skills levels with a particular target those at the lowest level of literacy and numeracy skill, *Skills for Life*.

Prior to Moser there had been various literacy campaigns using volunteers to help adults who had reading difficulties to master this basic skill (Hamilton & Hillier, 2006). *Skills for Life* adopted the quite different approach of professionalizing tuition through raising the skills level of tutors to that of a trained teacher, that is, a three-year degree, and supplying a standard curriculum with targets for adult learners to achieve. Initially the target was Level 2—the equivalent of a GCSE, A–C in literacy terms. Subsequently there was recognition of the need to target also those who were at a far lower level than this. The national qualifications framework in fact offered three levels at which targets were to be set: Level 2 (GCSE A–C equivalent), Level 1 (elementary qualifications), Entry Level (prequalification level). Within Entry Level itself there were three further divisions reflecting the incremental steps in progression that needed to be achieved: Entry Level 3 (the highest), Entry Level 2, and Entry Level 1 or below (the lowest). A national survey of adults, known as the “Skills for Life Survey of Basic Skills Needs,” identified 15 percent of the population at Entry Level, 30 percent at Level 1, and 55 percent at Level 2 or above.

Skills for Life provision is offered in a range of contexts including colleges of the kind discussed earlier, not far removed from the American community colleges in what they are attempting to do. The traditional adult education institutes, where nonvocational courses were offered and the early basics skills education was delivered, are now largely absorbed into the Further Education colleges within the vocationally oriented *Skills for Life* program. There are also various forms of community provision, especially in Scotland. In England these can include local community centers and venues like libraries (“Learn Direct”) and job centers (“Job Centre Plus”), where unemployed people can seek advice and be helped to find employment. Some of this community provision that may not fit strictly the *Skills for Life* progression criteria for funding may be supported by the Local Council with a view to linking the learner to the national program later. Other locations for basic skills provision include the workplace, with a major campaign directed at employers, to raise the skills levels of their employees, and other more specialized venues, such as prisons and young offender institutions.

Taken overall, the main distinction then between the U.S. and UK systems relates to the open nature of the American system, with extended education expected up to age eighteen for all and continuation to college for most who complete high school. In contrast, the British system assumes that many young people will leave school at the statutory minimum age, sixteen, if work is available, or to do vocational qualifications, apprenticeships, and so on. Despite the Level 2 target, *Skills for Life* provision is therefore likely to be taken up typically by adults who have left the system

at the earliest stage, many of whom have little or no accreditation and a large proportion of whom have very poor literacy or numeracy. In the United States, on the other hand, there is a national GED testing system but no national curriculum or teacher qualifications for adult literacy and numeracy education.

METHODOLOGICAL CONCEPTS AND ISSUES IN LONGITUDINAL STUDIES

As the reader peruses the chapters in this volume, it will become clear that conducting quality longitudinal studies of adult learners can be a daunting task. The researchers' accounts indicate they encountered many challenging problems in designing, implementing, and analyzing data in their longitudinal studies. It may be helpful to orient the reader here to a few of the key methodological problems and concepts that will arise in the chapters. There is not space, of course, to provide full coverage and technical background for these issues—for that, we will refer interested readers to other sources for more complete information about these topics.

We will mention three recurrent problems or issues that often arise in longitudinal studies: (1) sample attrition and missing data; (2) constructing measures and scales that are longitudinally stable; and (3) methods for analyzing change in longitudinal data. A few general references that are not highly technical but provide broad coverage of these and other important issues are Magnusson, Bergman, Rudinger, and Torestad's (1994) *Problems and Methods in Longitudinal Research: Stability and Change*; Saldaña's (2003) *Longitudinal Qualitative Research: Analyzing Change Through Time*; and Singer and Willett's (2003) *Applied Longitudinal Data Analysis: Modeling Change and Event Occurrence*. Additional references will be suggested below for in-depth treatment of particular methodological issues. Our discussion here is focused on quantitatively oriented longitudinal studies because most of the chapters in this volume are primarily quantitative in nature, though several of the studies employ mixed methods. There clearly needs to be more qualitative longitudinal research in this field. The Saldaña (2003) reference provides additional material about qualitative approaches in longitudinal studies in general.

SAMPLE ATTRITION AND MISSING DATA

A recurrent problem in longitudinal studies that follow adult learners over time is that they lose track of and/or fail to complete follow-up interviews and assessments with many of the individuals in their original sample. This problem is often referred to as sample attrition or lack of sample retention. All of the studies reported in this volume encountered this problem

to a greater or lesser extent. Sample retention rates vary widely and tend to increase with longer intervals between initial and follow-up interviews and with increasing numbers of follow-up interviews being administered to participants. One of the longitudinal studies had such sample-attrition problems that it was prematurely terminated by its funding agency. In other studies, researchers were able to complete their studies but cautioned about the validity of their findings given the relatively high rates of sample attrition they experienced.

There are many causes, of course, of sample attrition. Sometimes studies lose contact with their participants and are unable to locate them for follow-up interviews. Other participants die, become seriously ill or unwilling to continue participating in the study for various reasons. In some studies, participants initially are recruited while attending a basic skills program but leave the program before follow-up interviews are conducted, and their motivation decreases for continuing in the study. With careful attention, many of these problems can be overcome or at least ameliorated, as attested to by the low rates of sample attrition in some of the reported studies. A practical guide is provided by Strawn, Lopez, and Setzler (2000, 2007).

Sample attrition can be methodologically problematic for several reasons. First, the reduced sample size can become too small for reliable statistical estimation of important outcomes. This is primarily more a function of the absolute size of the reduced sample than of the percentage of the original sample lost to attrition. Sufficiently large initial samples may have adequate follow-up sample sizes even after substantial attrition. Often a more important issue is the potential *bias* introduced by sample attrition. To what extent are individuals who remain in the sample after attrition representative of the original population? To address this concern, researchers often report not only the percentage sample attrition but statistically test whether key characteristics of individuals retained in the sample differ from those of the original sample (e.g., gender, education, literacy level). We are often asked what is a reasonable sample retention rate for a longitudinal study in adult education. There is no simple guideline to provide here. When follow-up sample sizes are sufficiently large, the important question has to do with attrition bias that may be present and the analytical capacity to deal with such bias.

Even when evidence of attrition bias is present, statistical modeling techniques may be available to satisfactorily work with the longitudinal data at hand. The seminal work of Little and Rubin (1987) provides systematic theory and methods for evaluating the mechanisms producing missing data and analytical methods that can validly compensate for missing data under certain assumptions about the mechanisms producing the missing data. In the case of longitudinal studies, missing data can result from sample attrition or from other factors that make certain data items missing even when subjects are interviewed (e.g., a respondent refuses to answer a particular question). Little and Rubin (as refined by Little, 1995) classify missingness

as *Missing Completely at Random* (MCAR), *Covariate-Dependent Drop-out* (CDD), *Missing at Random* (MAR), or *informatively missing*. Without going into technical details here, we note that analytical techniques can compensate for missingness under the first three types of missingness, called *ignorable nonresponse* by Laird (1988). To use these techniques validly, however, researchers must first demonstrate that their missing data are indeed ignorable. Usually the easiest ignorability condition to satisfy is MAR. Technical algorithms for doing this with longitudinal data sets are provided by Diggle, Heagerty, Liang, and Zeger (2002, Chapter 13).

When missingness is nonignorable, serious methodological problems arise in trying to draw generalizable conclusions from the longitudinal data that are present. A common example of nonignorable missingness in longitudinal studies of adult education occurs when adults attending basic skills programs are followed over time to study attendance patterns and their impact on learning outcomes. In many such studies, students who drop out of the programs also tend to drop out of the longitudinal research project (Beder, 1999). This makes the missingness of follow-up data “informative” and thus nonignorable with respect to the dependent variables of interest. In such cases, complex statistical models may be needed that jointly model the nonresponse (i.e., missingness) of participants together with the distribution of the dependent variables.

CONSTRUCTING MEASURES AND SCALES THAT ARE LONGITUDINALLY STABLE

Many longitudinal studies in this volume seek to measure changes in complex constructs such as adults’ literacy and numeracy proficiencies, literacy and numeracy practices, attitudes towards learning and programs, and so forth. Developing psychometrically sound measures and scales for such constructs can be challenging even for cross-sectional studies in which measurements are taken only on single occasions. Additional challenges are posed in developing such measures for longitudinal studies in which a measure is to be repeatedly gathered for purposes of assessing change in the constructs over time.

An important concern in constructing scales appropriate for measuring longitudinal change is that they have a *longitudinally stable measurement component*. Traditional psychometric criteria for constructing scales from numerous individual questionnaire items can lead to satisfactory instruments for use on a particular occasion that are not valid as repeated measures for detecting change over time. Purcell-Gates and colleagues (2004), for example, constructed a scale of engagement in literacy practices from a large number of individual questionnaire items about individuals’ frequency of use of specific literacy materials and tasks. Using item response theory (IRT) to scale these items, they found a high degree of fit of the

items to an IRT scaling model and excellent psychometric properties. Yet when the same items were subsequently administered to subjects as part of a follow-up interview, the responses could not be adequately scaled with the same item parameters, and thus the scale scores on the two occasions could not be compared in order to assess change: the same construct was not being measured on the two occasions. This is an example of lack of measurement stability over time.

Even when using a standardized test with well-developed psychometric properties, such as a standardized literacy proficiency assessment, it is important to verify (rather than assume) that the instrument has a stable measurement component over time. With an IRT-based proficiency assessment, for example, the stability of item parameters over time can be judged (given sufficient data). If item parameters are not stable, then it is difficult to interpret observed changes in overall (i.e., IRT-scaled) proficiency scores.

Often factor analytic methods are used to identify latent variables (or factors) within subjects' responses to sets of questionnaire items. Structural equation models (SEMs) offer important extensions of classical confirmatory factor analysis to the longitudinal modeling context. Working with SEMs, analysts are able to specify separately the structural and measurement components of various models of interest. In the longitudinal context, analysts can statistically test important equality constraints among the loadings of variables at different time points within the measurement component. Where such equality constraints cannot be statistically rejected, the latent variables (scales) are said to have longitudinally stable measurement properties. Farrell (1994) provides some relevant theory and examples for such work with SEMs in panel studies.

METHODS FOR ANALYZING CHANGE IN LONGITUDINAL DATA

Longitudinal studies in adult education offer the potential for understanding the processes of literacy and numeracy development over the life span, the consequences of those changes for other aspects of adult life, and some of the factors and interventions that influence the changes that take place. The careful design and implementation of such longitudinal studies are paramount; the analysis of the collected data is obviously very important as well.

An important motivation for conducting longitudinal studies is to be able to identify causal relationships between certain experiences (e.g., attending a basic skills program) and observed changes (e.g., improved basic skills, increased earnings). Although correlational evidence may often suggest causal relationships, it rarely provides conclusive evidence. Within longitudinal studies, additional evidence of *temporal ordering* (such that changes in one variable precede changes in another variable) and the *inclusion of all relevant variables* in the analysis are generally required to provide persuasive

evidence of causality. When key explanatory variables are omitted from an analysis of the relationship between two variables of interest, it is inappropriate to conclude that correlation implies causality. An omitted variable correlated with each of the two variables could be responsible (rather than a causal link) for their observed correlation. The difficulty, of course, is in demonstrating that all relevant variables have been included. This is why random assignment of subjects to experimentally controlled conditions is seen as the “gold standard” for identifying causal relationships: with sufficient numbers of individuals randomly assigned to various conditions, the effects of *all* omitted variables are effectively controlled.

Experimental controls, however, are often difficult to implement effectively with adults. Only one of the studies in this volume attempted to do so. Other techniques are used in data analysis to examine potential causal relationships among key variables of interest. Repeated-measures analysis of variance and regression-based methods are the most commonly used methods in the studies within this volume. These methods can be difficult to use in longitudinal studies because they typically require *balanced* data, that is, the same number of observations on each variable in the analysis. Because of the prevalence of missing values in longitudinal studies (see earlier), this requirement typically results in *listwise deletion* of data, that is, eliminating any subject from the analytic data set who does not have balanced or complete data on all relevant variables. Such listwise deletion reduces the sample size, sometimes drastically, and raises questions about the representativeness of the remaining balanced data. Alternatively, *imputation* techniques are used in some studies to create balanced data sets by statistically estimating and filling in the missing values (Rubin, 1987). One of the studies reported in this volume uses such techniques.

Other approaches to longitudinal data analysis are based on *structural equation modeling* (SEM). Structural equation models allow the researcher to specify a variety of complex relationships among both observed variables and latent variables. As noted previously, SEMs also allow researchers to separate structural components (specifying relationships among key latent variables) from measurement components in models, which is very important for confirming that the latent variables are being measured in the same way at various time points of a panel study. Another important feature of SEMs for modeling longitudinal data is their capacity to model cross-domain relationships such as the relationships between changes in basic skills and changes in other aspects of individuals' lives, such as changes in employment, in earnings, in uses of technology, and so on. There is a rich literature, numerous introductory texts, and software that are especially useful for panel data applications of SEMs (e.g., Bentler, 1995; Joreskog & Sorbom, 1993; Maruyama, 1998; Muthén & Muthén, 2006; Singer & Willett, 2003).

A widely used family of techniques for analyzing panel data is called *latent growth curve* models. Two of the studies in this volume use these techniques

extensively. Growth curve models focus on the systematic properties of change over time in repeated measures such as literacy proficiency. Taking their name from the familiar graphs of children's changing heights and weights over time, growth curve models seek to fit growth curves from a selected family of functions (e.g., linear growth curves, quadratic growth curves, etc.) to *individual* changes in a measure over time. Optimal estimates of each individual's growth curve parameters can be made based on the entire longitudinal data set (not just the selected individual's data). In fitting linear growth curve models, for example, person-specific intercepts and slopes are estimated. In fitting quadratic growth curves, person-specific intercepts, slopes, and curvatures (i.e., rates of acceleration) are estimated. Techniques are also available for estimating how various time-independent and time-varying covariates influence the shapes of individuals' growth curves (i.e., the values of their growth curve parameters; Goldstein, 1995; Raudenbush & Bryk, 2002). Depending on the type of growth curve modeling involved, these individual parameter estimates are called *empirical Bayes* estimates (in multilevel models of growth curves) or factor scores (in SEM models of growth curves).

There are a number of different approaches to modeling growth curves. Two of the most commonly used ones are multilevel or hierarchical linear models (Goldstein, 1995; Raudenbush & Bryk, 2002) and SEM-based models of growth curves (Bollen & Curran, 2006). There are important overlaps between these two approaches to modeling growth curves, as well as some important differences between them (Willett & Sayer, 1994). The multilevel models do not require balanced data as do the SEM-based models. Since almost all panel data sets in practice have missing data, multilevel models are more easily applied to the full data sets that are collected. To utilize the SEM growth models with unbalanced data sets, one either has to utilize listwise deletion or imputation to create balanced data sets for analysis (see earlier). In all cases, it is advisable to test unbalanced data sets for their structure of missingness as described previously, though this seems rarely to be done in practice. SEM-based models, on the other hand, can be constructed with a broader range of error covariance structures for growth curve modeling than their multilevel counterparts can. There are thus trade-offs between using the two approaches to growth curve modeling.

ORGANIZATION OF THE BOOK

Although most of the longitudinal studies reported in the volume focus on the impact of program participation on literacy and numeracy development, some of the studies consider skills growth and program impact within a broader focus on changes in adults' lives. In these studies, participation in programs is but one of the life experiences potentially linked to basic skills development over time. Both qualitative studies and surveys collecting broad information about adults' activities and life experiences

provide lenses for examining the influence of program participation and other activities on the development of adults' basic skills, attitudes, and other attributes. A few of these studies include both program participants and nonparticipants, whose systematic comparison can deepen our understanding of the role of participation.

The longitudinal studies reported in the book are organized into four sections. The chapters in the first section consider findings from several broad longitudinal studies of adults over time. Both those participating in basic skills programs and those not participating are part of the studied populations, and many social and economic dimensions of life changes are explored in addition to education and skills progression. The second section comprises longitudinal studies specifically of students, teachers, and classrooms in adult basic skills programs. Chapters in the third section present a range of longitudinal studies that examine the impact of such instructional programs (and of the policy environment within which they operate) on adult students' learning outcomes. The fourth section includes a variety of longitudinal studies that examine the broader impact of programs on individuals' social and economic outcomes.

PART I: LITERACY AND NUMERACY DEVELOPMENT

Several longitudinal studies reported in this section look broadly at changes in adults' lives and how literacy and numeracy abilities are constitutive of those changes. Because these studies generally follow a broad segment of the adult population over time, rather than just those adults who choose to participate in basic skills programs, they provide an important lens for viewing the impact of programs and policies on basic skill development and other aspects of adults' lives.

John Bynner and Samantha Parsons write about their research based on the experiences of a large cohort that has been followed from birth through adult life in the United Kingdom. In their chapter, they describe how individual differences in literacy and numeracy abilities, already evident in measures taken during childhood, are relatively stable across the life span and exert profound influences on a range of educational, economic, and family outcomes in adult life. By comparing the sizes of the regression coefficients between basic skills and various indicators of social and economic status at different ages (while controlling for differences in many other variables), Bynner and Parsons argue that many changes in adult life are in fact mediated by earlier skills acquisition. They suggest that greater emphasis be concentrated on supporting basic skills development in the early childhood years and that additional research examine the smaller but still formative role of various life experiences between the ages of sixteen and thirty on literacy and numeracy development, especially employment opportunities and experiences.

Stephen Reder presents some findings from a long-term longitudinal study of a population of high school dropouts in the United States. Repeated measures of both *proficiencies* and *practices* in literacy and numeracy provide data that are analyzed by growth curve methodology in order to understand basic skill development in adults. Although proficiency and practices measures are correlated and both change systematically in adult life, Reder's analyses indicate these measures are subject to different dynamics of change. Participation in basic skills programs, for example, has a clear impact on measures of literacy and numeracy practices but not on proficiency measures. Pronounced effects of age were found on proficiency changes, such that younger adults tend to gain proficiency (through their early 30s), whereas older adults tend to lose proficiency over time. Reder suggests that the design and evaluation of basic skills programs be based on improvements in everyday literacy and numeracy practices rather than on just proficiency growth (the prevailing policy in the United States). He also suggests that new types of programs and policies may be needed to meet the skill development needs of our aging populations and workforces. Reder's research indicates that literacy and numeracy growth in adulthood is the byproduct of ongoing developmental processes as well as life-event-driven changes. He suggests that future research should examine the key role of workplace experiences in mediating literacy and numeracy development.

T. Scott Murray presents results from several longitudinal studies in his chapter, conducted with various populations of school-aged children and adults in Canada and New Zealand. Murray's analyses of the data from these studies commonly focus on understanding processes of skill gain and loss over the life course. Murray's analysis of a longitudinal study of skill development in New Zealand primary and secondary students is consistent with Bynner and Parson's finding that individual differences in basic skills are laid down early in childhood and remain relatively stable across development. His "synthetic cohort" analyses of the Canadian data sets from two large international adult literacy surveys attempt to reconstruct longitudinal changes that took place historically by comparing distributions of skills in different age groups at fixed points in time. These analyses indicate that individuals' skill gains and losses vary systematically with a number of factors, including age and socioeconomic status. Murray's finding that there is more skill loss in older populations is generally consistent with Reder's finding based on direct measurement of proficiency changes (note that Murray and Reder analyze data based on quite similar proficiency measures). Murray also concludes that skill losses are highly concentrated among individuals in the lower socioeconomic quartile and among individuals with initially lower levels of skill. Looking at parallel data from a number of countries, Murray concludes from these inferred patterns of skill gain/loss that literacy and numeracy skills are the single most important determinant of societal economic growth since World War II. He argues that new policies and investments to support adult literacy and numeracy development will have larger economic returns.

All of these studies find that literacy and numeracy do indeed continue to develop across the life span. A variety of contextual, economic, and cognitive factors systematically influences these developmental processes. Although much differentiation of literacy and numeracy abilities occurs during childhood, additional variance occurs during adult life. Understanding the life events and activities shaping this adult development is important for policy and program development. The longitudinal studies in the sections following consider the effects of program participation on adult basic skills, one promising place to look for leverage through increased investment and policy attention. In addition, the contributions in this first section by Bynner and Parsons, by Reder, and by Murray each point to the need to look more closely at the formative role of work in mediating the growth of literacy and numeracy in adult life.

PART II: STUDENT, TEACHER, AND CLASSROOM STUDIES

The chapters in this section look closely at variations in literacy and numeracy instruction in classrooms and tutoring programs. The authors attempt, through a variety of analytical methods, to identify particularly effective instructional techniques and approaches based on differences in learners' longitudinal outcomes. Both qualitative differences among program features and quantitative differences in student persistence in programs are considered.

Judith Alamprese reports on a longitudinal study of low-level students in Adult Basic Education programs across the United States. Students in this study were taken from 130 programs and had decoding skills in the 0–3rd grade range as measured by a standardized reading test. A number of students' reading subskills were assessed two or three times as they entered, continued to participate in, or after they left the programs. Observers carefully noted, in this “what works” study, characteristics of the classroom instruction the students encountered. Multivariate analyses were then used to identify the student characteristics and instructional factors associated with reading subskill gains. The strongest predictor of reading gains was pretest score. This finding is reminiscent of Murray, who, we recall, looked at skill gains on a proficiency measure within a broader adult population and found that gains over time were smallest among adults already in the lowest quartile of skill. Whenever such studies find strong relationships between the initial value of a measure and its subsequent gain over time, growth curve analyses can be quite helpful for better understanding of the relationships between initial status and rate of change. Alamprese discusses a range of implications of her research for the delivery of services to low-level adults, including implications for assessment, program management, and professional development of teachers.

Another “what works” study is reported in the chapter by Larry Condelli, Heide Wrigley, and Kwang Yoon. Their longitudinal study was parallel to Alamprese’s but focused on instruction for adult ESL “literacy” students—ESL students who lack basic literacy skills in any language and who have minimal proficiency in English. The two “what works” studies were funded by the U.S. Department of Education to address similar questions in different components of the federally funded basic skills programs for adults, Adult Basic Education and English as a Second Language. These common questions had to do with which instructional practices “work,” that is, produce more learning. Condelli and colleagues demonstrate that instructional practices are related to student learning. Using growth curve modeling, they identified three instructional strategies that are related to literacy and language learning: connection to the outside world, use of the student’s native language for clarification in instruction, and varied practice and interaction. They discuss the range of specific teaching activities encompassed by these three strategies and analyze how student characteristics influence the learning process. They remind us that despite the clear relationships among these variables and learning outcomes, they cannot determine which specific instructional activities will *cause* basic reading skills to improve. They argue that only random assignment experiments contrasting the learning outcomes associated with particular instructional practices can support such causal inferences.

Although both of these studies found that the amount of time that students spend attending basic skills classes is positively associated with improved learning outcomes, neither study found that students attend the programs for substantial periods of time. A recent representative national survey of programs and learners in the United States found that students attend basic skills classes for an average of only eighty to one hundred hours (depending on the program type). John Comings and colleagues have conducted research on student attendance in adult-education classes and the factors associated with attendance. Comings, Parella, and Soricone (1999) proposed the term *persistence* to describe adult students’ engagement in self-directed study or distance education between periods of attendance in face-to-face programs. Reder and Strawn (2001, 2006) extended this idea to many adults who they found self-study to improve their reading, writing, and math skills but *never* attend any basic skills classes. In his chapter in this volume, Comings reviews research on persistence with special attention to the National Center for the Study of Adult Learning and Literacy’s (NCSALL) longitudinal Persistence Study. He synthesizes the research into a systematic theory of persistence and suggests ways in which programs can better support learning through three chronological phases of participation: Entrance into Services, Participation in Services, and Reengagement in Learning.

All of the chapters mentioned thus far in this section—Alamprese, Condelli et al., and Comings—acknowledge the important role that teachers play in students’ learning, though none of these studies was designed to focus on teacher variables systematically. Olga Cara and Jennifer Litster

examine adult-education teachers more closely in their chapter about some early findings from the NRDC Teachers Study. They focus on the longitudinal formation of teachers' attitudes towards innovations in policy and programs in adult literacy and numeracy. Understanding how teachers respond to such innovations, of course, is central to planning effective future initiatives. Cara and Litster consider the formation of teachers' attitudes towards the national *Skills for Life* strategy in England. Although the longitudinal Teachers Study was still in progress at the time their chapter was written, Cara and Litster identified a number of key findings based on the first two waves of attitudinal data. With many other variables controlled by multivariate regression, they found that positive attitudes in teachers towards *Skills for Life* are associated with participation in professional development activities, with being change agents within peer networks, and with understanding new credentialing requirements. Cara and Litster conclude that teachers' responses to innovations may depend less on *what* those changes are and more on whether they feel ownership over the changes and continued empowerment and autonomy to help improve learners' lives.

A companion study to the Teachers Study is the NRDC Learners Study. Just as the Teachers Study, described earlier, examines the impact of the British government's *Skills for Life* initiative on teachers, the Learners Study investigates its impact upon adult learners. John Vorhaus, Ursula Howard, Yvon Appleby, Ann Marie Bathmaker, and Greg Brooks write about some of the initial findings of the Learners Study, which consisted of multiple strands of data and analysis about the characteristics of learners, their participation in *Skills for Life* programs, and their achievements. A common focus across the longitudinally focused research strands was how the evolving infrastructures of *Skills for Life* related to the changing characteristics and experiences of successive cohorts of learners. Their chapter describes the methods used, descriptive summaries of the data collected, and the methodological problems encountered in attempting to capture the impact of a major government initiative upon a diverse population of adult literacy and numeracy learners.

PART III: THE IMPACT OF POLICY AND PROGRAMS

The previous section described research focusing on the processes and outcomes of learning in the context of the student-teacher relationship. In this section we continue to pursue this issue but more broadly in terms of the impact of teaching programs at different levels and the implications this has for improving policy. An important methodological issue arises that we need to return to again. The idea of impact suggests some direct causal relationship between a particular intervention/treatment as applied in this case to individual learners on skills proficiency and on a given outcome in the labor market or in the workplace, in relation to the criminal justice system or for

personal development. Establishing causality is the province of research design where the randomized controlled experiment reigns supreme as supplying the most robust basis for causal inference. Only one of the studies reported here embarked on a course involving such a design, and even then the design could not be sustained. Nevertheless, the other studies provide in their different ways powerful indicators of the impact programs have, relying on statistical forms of control and multiple sources of information triangulated against each other in place of randomization.

The projects reported in this section are important in relation to the insights they give on the way major political priorities, as enshrined in this case in the *Skills for Life* program in England, were reflected in specific teaching programs and projects with a major basic skills component. They also show how these fitted into what was not a fixed or static national program for evaluation but, as is typically the case, a continually evolving policy field. For example, subsequent to the research reported here being undertaken, a major government report in Britain—the *Leitch Report*—was published on raising skills levels generally in the population in which enhancement of literacy and numeracy language was presented as the first step (HM Treasury, 2006). Connections from basic literacy and numeracy enhancement to the vocational programs of skills enhancement set out in this highly influential report, and endorsed completely by government, will themselves be likely to impact further on the way that basic skills themselves are taught. Supported strongly by research (Casey et al., 2006), the idea of “embedding” basic skills teaching in vocational education and other programs, rather than treating it as relatively independent of the rest of the curriculum, is increasingly gaining momentum. This recognizes the motivational value and effectiveness of provision that map directly into the vocational and other goals that learners are pursuing.

The three studies reported comprise one by Hilary Metcalf and Pam Meadows on the major evaluation undertaken of *Skills for Life* as a whole in raising literacy levels and achieving other outcomes based on follow-up surveys of identified *Skills for Life* learners and the general population sample used in the 2002 *Skills for Life* Survey. In their project on *Skills for Life* in the workplace, Karen Evans and colleagues report research conducted in one of the target areas for *Skills for Life*, as reflected in the high priority given in the *Moser Report* to work-based learning. Despite the high prevalence of low-skilled individuals in many workplaces, few employers, until the publication of the Moser report, had taken the problem at all seriously. Skills for Life placed major emphasis on recruiting employers to the goal of enhancing their workers’ skills and provided support in terms of curricula and teaching, as appropriate, or supporting indigenous programs within workplaces. The project focused on workers in a number of workplaces, examples of which were very difficult to build up into a list because of the relative rarity of the provision. Mixed methodology was employed using quantitative methods to assess progress, employing tests

developed especially for the purpose and qualitative methods to investigate workers' experience of the program in detail. The third project reported here was directed at another specialized population—young people in the criminal justice system—where again there is a high prevalence of poor literacy and numeracy reflecting the very low educational achievements of large numbers of young offenders. Young offenders are located in institutions known as the “secure estate” or are engaged as part of their sentence in community-based education and training. The project started with the aim of undertaking a randomized control trial in which the new *Skills for Life* curriculum, adapted especially for the age group of young offenders, would be offered to individuals selected at random from a total group. For a number of reasons detailed in the chapter, which are of great interest, such a design could not be implemented, and a survey without randomization supported by qualitative methods had to be used instead.

Overall, the three projects reveal both problems with the assumptions on which so much intervention through government programs is based and the complexity of experiences that have to be captured in any research attempting to understand impact. They also provide important lessons about the practical problems of maintaining strictly to the canons of classic research design and how the necessary adjustments can reveal new insights that otherwise might be missed.

PART IV: SOCIAL AND ECONOMIC OUTCOMES IN CONTEXT

Adults normally engage in literacy and numeracy classes for a clearly defined purpose. Unless their motivation is high, they are unlikely to be persuaded to take part (even if their skills are poor) and when they do so often have great difficulty in “staying the course.” Motivation is therefore a critical factor in the effectiveness of adult teaching, which may come from the effectiveness of the teaching itself and the feeling of self fulfillment it produces or, more frequently, the context of people's lives in which the decision to join a course emerges. Such contexts include the family, the community, and the workplace, and often it is changes in these situations that prompt interest in, and the decision to improve, the basic skills. Thus, a child starting school or a workplace change, including the possibility of redundancy, or taking on office in a local club, may all heighten interest in improving skills. In the absence of such motivational triggers, most adults are likely to feel that, as far as their own lives are concerned, they cope.

The set of studies reviewed here approaches these issues from a number of angles employing a range of resources and methods. Stephen Rose uses U.S. state administrative records to evaluate adult education programs focusing particularly on participation and what might explain it in terms of the different socioeconomic characteristics of students. The report by Mary Beth