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Methodological Advantages of Panel Studies

Designing the New National Educational Panel Study (NEPS) in Germany[1]

Abstract

There is a huge demand for high-quality data as education is a key factor in modern societies for individual life courses and chances as well as for economic growth. The need for panel data in case of observational studies is explained by us because describing and testing theories on causes and consequences of educational careers is highly limited using cross sectional data. Consequently a National Educational Panel Study (NEPS) has been established in Germany. Besides the methodological advantages of panel data such an instrument needs a strong theoretical base. We give a short overview on the major topics and characteristics of German longitudinal studies as well as some notes on the situation in other industrialized countries. Considering different strategies used in Germany and elsewhere and the need to provide fast and up-to-date information on educational processes, we opt for a multi-cohort-sequence design. This means, that the NEPS starts with six different cohorts at important stages in the educational career or life course within a small time range and that samples will be refreshed later on. To get detailed information on the learning environments and to capture the influences of parallel processes on competence development and educational choices we also survey the parents and the teachers of the minor persons.

Keywords

educational research, causal analysis, designing panel studies, NEPS

Methodische Vorteile von Panelstudien

Das Erhebungsdesign der neuen Nationalen Bildungspanelstudie (NEPS)

Zusammenfassung

Der Bedarf an qualitativ hochwertigen Daten ist in der Bildungsforschung groß, da in modernen Gesellschaften Bildung eine zentrale individuelle Determinante für wirtschaftliche und gesellschaftliche Teilhabe und die Ausgestaltung von Lebensverläufen ist. Zugleich ist sie auf gesamtgesellschaftlicher Ebene für wirtschaftliches Wachstum bedeutend. Um Bildungsprozesse und -verläufe, ihre Determinanten sowie kurz- und langfristige Konsequenzen untersuchen zu können, sind jedoch Paneldaten notwen-

1 The NEPS project is being financed by the Bundesministerium für Bildung und Forschung (Federal Ministry for Education and Research, BMBF).

dig. Querschnittsdaten sind kaum geeignet, um dynamische Prozesse zu beschreiben oder diese theoriegeleitet zu prüfen. Deshalb wird in Deutschland eine Nationale Bildungspanelstudie etabliert. Nach Darstellung der methodischen Vorteile von Paneldaten geben wir einen Überblick über die Themen und Erhebungsmerkale von in Deutschland bereits durchgeführten längsschnittlichen Bildungsstudien und erläutern die Situation in anderen Ländern. Ein Multi-Kohorten-Sequenz-Design bietet die einzige Chance, rasch möglichst viele Informationen zu gewinnen. Deshalb starten vier Kohorten an für das deutsche Bildungssystem charakteristischen Stellen sowie eine Kohorte mit Neugeboren und eine mit Erwachsenen. Um detaillierte Informationen zu den Lernumwelten und zu relevanten, parallel stattfindenden Prozessen zu gewinnen, werden nicht nur die Zielpersonen befragt und getestet, sondern auch ihre Eltern und das pädagogische Fachpersonal, solange die Zielpersonen das allgemeinbildende Schulsystem noch nicht verlassen haben.

Schlagworte
empirische Bildungsforschung, Kausalanalyse, Konzeption von Panelstudien, NEPS

Introduction

Today, more so than in the past, education is a lifelong process where individuals continually learn in formal, non-formal, and informal environments throughout the life-span. Individuals' educational careers and competencies and how they unfold over the life course in relation to family, educational institutions, workplaces, and private life are therefore a topic of major national interest.

There is widespread consensus that panel data and the methodological advantages they provide are essential for rigorously addressing the types of questions that drive and are central to life-course-oriented educational research (Halaby, 2004, p. 503). In particular, panel data improve opportunities to describe trajectories of growth and development over the life course and to study the patterns of causal relationships over longer time spans. The strengths of panel data are particularly evident when they are compared with the commonly collected cross-sectional data.

Available multi-purpose panel studies such as, for example, the German Socio-economic Panel Study (SOEP) and the new German Family Panel are of limited use relative to the study of education as an ongoing process. In particular, they provide only small numbers of observations for specific groups of individuals at various educational branching points, they do not measure domain-specific competence development over the life course, they lack information covering the educational decision process, and they provide only a partial coverage of various educational environments.

These concerns led to the development in Germany of a new survey called the National Educational Panel Study (NEPS). The consortium formed to undertake this major task is working under the direction of the principal investigator Professor Hans-Peter Blossfeld. The consortium represents a network of excellence in that the researchers come from various disciplines (such as psychology,

education, pedagogy, sociology, economics, demography, migration studies, statistics, and survey methods) and major research institutions (DIPF in Frankfurt, HIS in Hanover, IAB in Nuremberg, ifo in Munich, IFS at TU Dortmund, IPN in Kiel, WZB in Berlin, and ZEW in Mannheim). Experts from various universities are also strongly engaged in the project (Free University Berlin, Bamberg, Giessen, Hamburg, Hanover, Kiel, Mannheim, LMU Munich, Siegen, and Tübingen). Leading scientist from other universities or major research institutes are participating in the consortium, too (These organizations include BIBB in Bonn, the University of Bochum, DJI in Munich, ifb in Bamberg, ifp in Munich, the Technical University of Dresden, the University of Goettingen, HAW Hamburg, and MPIfB in Berlin). The NEPS is located at the Institute for Longitudinal Research (Institut für bildungswissenschaftliche Längsschnittforschung, INBIL) at Bamberg University.[2]

The proposal to establish the NEPS received a positive evaluation from the German Research Foundation (DFG) in 2008, and the study is financed by the Federal Ministry for Education and Research (BMBF). The study will make a big step forward in terms of our understanding of educational processes and outcomes because its core emphasis is education over the life course. More particularly, it will create a sound scientific evidence base that will allow us to address a broad range of basic and applied questions concerning the field of education. Answers to those questions will inform policymaking.

The main purpose of the article is to discuss the methodological advantages of panel data, to give an overview of existing longitudinal studies in the field of education, and to describe the design of the upcoming NEPS. However designing an instrument that captures educational processes must be based not only on methodological aspects, but also on a strong theoretical paradigm focusing on the following topics: development of different competence domains; social inequality and educational decisions over the life course; the importance of various learning environments in diachronic and synchronic perspectives; the specific situation of immigrants and their descendants; and the returns to education across different life domains (Blossfeld, Schneider, & Doll, 2009). We focus, in this article, on the methodological aspects.

Methodological Advantages of Longitudinal Data on Educational Processes

In Germany, most empirical evidence drawn from educational research is cross-sectional in nature (as in the data obtained from various international student assessment studies such as PIRLS, PISA, and TIMSS). As such, we generally have available only a snapshot of the achievement of different students at a particular point in their educational careers. Although the successive snapshots obtained from series of cross-sectional surveys highlight the changes in the structure as a whole,

2 For more details, see www.bildungspanel.de.

they do not show the changing (and sometimes) unchanging experiences of individual students as their educational careers progress.

Coleman (1981) stressed that we must be very cautious when using single cross-sectional observations, because the data often suggest that the process under study is characterized by stability. However, when we study educational careers, change and development seem to be the rule rather than the exception. For example, an educational career consists of the sequence and timing of participation in certain age-graded and institutionally structured educational processes. Because panel data are derived from many individuals measured on several occasions across time, they allow us to describe these patterns of change over the life course. These data make it especially possible for us to trace the magnitude and regularity of change across groups defined by different characteristics and/or by exposure to different life-course experiences. Even if there is stability on some measures at the individual level, recourse to temporal data is the only means by which we can demonstrate that this stability does exist (Tuma & Hannan, 1984).

The notions of development and educational career also suggest a focus on the dependencies among the successive states occupied by an individual over time. Life-course research shows, for example, that the *events* and *states* of earlier educational stages often have consequences for later educational processes and outcomes (Mayer & Müller, 1986; Mayer & Tuma, 1990). Dannefer (1987) introduced the so-called *Matthew effect* into the literature on the life course. The Matthew effect means that initial educational inequalities become magnified over the life span. Thus, there seems to be a logic in educational careers that the "already educated get even more education" and the "poorly educated get poorer." The Matthew effect is sometimes also referred to as the *cumulative disadvantage/advantage hypothesis* (O'Rand & Henretta, 1999).

There are also complex layers of selectivity in educational careers (Cameron & Heckman, 1998), which means there is a strong likelihood of only quite specific individuals entering specific schools or parts of the education system over time. Thus, educational research has to take into account the details of educational histories as an indispensable factor in understanding the present. In general, cross-sectional data are not very suitable for achieving this goal because most of these datasets provide only a little retrospective information. In addition, if the performance is assessed only at one single point in time, as is the case with PISA, we remain unclear as to whether and to what extent these observed competencies are indeed relevant for the individual's future success in the education system or the labor market. A prospective panel study such as the NEPS that follows individuals up over longer periods of time in the future, therefore, can help to answer this kind of question.

Educational careers in Germany are often structured by transitions linked to career lines. Every transition implies that we need at least two observations – one at the origin state (at time t) and the other at the destination state (at time t+1) – to describe the flows of individuals at the various branching points of the education system. Educational transitions therefore cannot be studied with cross-sectional

data. Panel data offer an excellent opportunity to analyze these transition processes in educational careers over the life course.

The goal of seeking scientifically based evidence for causal relationships in educational research leads to design questions such as which inference model is appropriate to specify the relationship between cause and effect and which data and statistical procedures can be used to determine the strength of that relationship (Schneider, Carnoy, Kilpatrick, Schmidt, & Shavelson, 2007). Two different models of causal inference have dominated the work of practitioners in educational research over the last three decades: (a) causation as robust dependence, and (b) causation as consequential manipulation. David Cox (1992) has also proposed a third understanding of causation as a generative process, an understanding that seems particularly relevant for a more systematic and theoretically grounded life-course perspective.

The "causation as robust dependence" approach – which, in multiple regression, is known as the "control-variable" approach (Blalock, 1970) – is often applied in cross-sectional studies. The advocates of this approach call X a "genuine" cause of Y insofar as the dependence of Y on X cannot be eliminated through the introduction of additional variables into the statistical analysis. Thus, in this approach, causation is established essentially through the elimination of spurious (or non-causal) influences.

Although this approach has dominated the social sciences for several decades, it is today considered too limited. A major problem with cross-sectional data is that they cannot be used to establish the time order of cause and effect variables. Researchers accordingly have to make strong assumptions about the direction of causality. Moreover, because scientists rarely know all of the causes of observed effects or how they relate to one another, we cannot be assured that all other important variables have been controlled for (Shadish, Cook, & Campbell, 2002). A variable X can therefore never be regarded as having causal significance for Y in anything more than a provisional sense (Goldthorpe, 2001).

The second understanding of causation as consequential manipulation seems to have emerged as a reaction to the limitations of causation as robust dependence. Instead of "establishing the causes of effects," Holland (1986, 1988) and Rubin (1974, 1978, 1980) concerned themselves with "establishing the effects of causes." They made clear that a more to the point approach is to take causes simply as given, and to concentrate on the question of how their effects can be securely measured. According to this approach, causes can only be those factors that could serve as treatments or interventions in well-designed controlled experiments or quasi-experiments.

However, in the educational sciences, the situation under which causal inferences are drawn is often complex and complicated. In many situations, randomization is practically or ethically unacceptable, and strict experimental controls are often hard to apply. Thus, life-course researchers can only rarely apply well-designed randomized controlled experiments or quasi-experiments, and they must

base much of their causal inference on non-experimental observations of social processes.[3]

Because observational data are often highly selective, Rubin (1980) and Holland (1986, 1988) recommended in their empirical work that social scientists should make the process of unit assignment itself a prime concern of the inquiry. A whole battery of statistical techniques has been developed to help researchers approximate randomized controlled experiments with observational data (see, for example, Schneider et al., 2007). These methods include *fixed-effects models* (i.e., the adjustment for fixed, unobserved individual characteristics), *instrumental variables* (i.e., a method to correct for omitted variables bias due to unobserved characteristics), *propensity score matching* (an approach in which individuals are matched on the basis of their observed aggregate characteristics), and *regression discontinuity designs* (in which samples and comparisons between groups are restricted to individuals who fall just above or just below a specific cut-off point and are likely to be similar on a set of unobserved variables).

Panel designs are particularly strong in dealing with the threats of unit heterogeneity and temporal instability (Allison, 1994; Halaby, 2004; Hsiao, 1986; Maddalla, 1986). Unit heterogeneity means that the units compared are different and, hence, heterogeneous with respect to the stable unobserved properties that can confound the attribution of effect to the causal variable. Because, in panel studies, the same units are observed at different times, many unobserved properties remain stable and, hence, can be ruled out as explanations of change in the response variable by so-called "fixed-effects" or "difference-in-difference" estimators. Temporal instability means that, over time, changes in unobserved exogenous variables offer alternative explanations for researchers interested in assessing how changes in explanatory variables bring about changes in a response variable. The temporal stability that comes with observing different units at the same time can be exploited to deal with temporal instability in unobserved influences that threaten inferences from longitudinal data.

In addition to these unobserved heterogeneity models, the effects of time-varying and time-invariant explanatory variables on the time trajectory of a response variable can be estimated in growth models (McArdle & Epstein, 1987; Willet & Sayer, 1994). A major attraction of multilevel (Goldstein, 1995) and hierarchical models (Snijders & Bosker, 1999) is the very flexible estimation of growth trajectories.

A serious issue for the social scientist arises from the insistence of the exponents of the causation-as-consequential-manipulation approach that causes must be subject to manipulation by an experimenter or intervener – at least in princi-

3 Of course, a panel design such as the NEPS can take advantage of "natural experiments" in the education system. In Germany, the various federal-state governments (Bundesländer) are responsible for general and vocational schools and the universities. Implementation of reforms in the education system thus often varies across the Bundesländer, which means the impact of educational reforms can be studied as a kind of "natural treatment effect." Evidence from different time points can serve to improve the evaluation or planning of policies.

ple (see, for example, Holland, 1986). The idea is that once the treatment or intervention is introduced, it will quasi-automatically lead to an outcome. The units of analysis in the social sciences, the individuals, are therefore assumed to be passive subjects whose behavior is explained only by causal factors and their "... objectives, knowledge, reasoning and decisions have no further relevance" (Goldthorpe, 2001, p. 8).

This understanding of causation clearly reduces the testability of relevant theories and models in the social sciences. In particular, it does not seem compatible with the micro-foundation of modern sociological theory in which actors are considered to have agency: individuals have objectives and knowledge. When faced with a choice between different courses of action, they will make decisions. Thus, the causation-as-consequential-manipulation approach has a limited bearing for social scientists who have moved on conceptually from "factor-based" to "actor-based" models (Macy, 1991; Macy & Willer, 2002).

These issues lead us to the third understanding of causation as a generative process. According to Cox (1992), of crucial relevance to the claim of a causal link is elaboration of the underlying generative process that exists in time and space. A causal association between X and Y must be considered as a product of a process, created by some (substantive) mechanism. A major shortcoming of the approach to causation as robust dependence and the approach to causation as consequential manipulation is that neither provides an explicit notion of an underlying generative process. Thus, causation as a generative process seems to be a necessary expansion of these two understandings of causation.

When considering causation as a generative process, it is important to realize that the role of time in causal explanations does not just lie in specifying a temporal order in which the effect follows the cause in time. It additionally implies that there is a temporal interval between the causal event and the effect event. Thus, some finite amount of time is needed for the cause to produce a detectable effect. For example, when a student enters a new school, some time may lapse before we can observe any effect on his or her competence level. This time interval may be very short or very long, but it can never be zero or infinite (Kelly & McGrath, 1988). In some causal relationships, effects occur almost instantaneously. In other cases, effects imply lengthy time lags between the causal event and the appearance of an effect that must be specified and modeled in an appropriate causal analysis. In current cross-sectional analyses in educational research, this interval between causal and effect events is simply left unconsidered and unspecified. Only temporal data allow the researcher to address and model such temporal lags.

In addition to the matter of how long the lag is between the timing of the cause and the beginning of the unfolding of the effect, different patterns might also emerge in how the causal effect develops over time. It is rarely the case that the effect is time-constant. For example, the development of students' competencies in a new school environment is likely to increase in a non-linear fashion over time. However, if the causal effect increases or decreases monotonically or linearly over time, oscillates in cycles, or shows any other complicated time-related pattern, then

the strength of the observed (cross-sectional) effect is dependent on the timing of the observation.

Contemporary educational theories in sociology, economics, and psychology emphasize individual change and its institutional and historical contexts. Context effects exist at different aggregation levels and refer to situations in which changes in the group context themselves influence the dependent variable. Understanding change in educational pathways therefore requires not only time-related data at the individual level but also time-related context information. This information tells us about the growth and decline of personal components under different environmental conditions. Temporal data are much better suited than cross-sectional data to the identification of such influences at different aggregation levels.

Finally, longitudinal studies are able to show whether competence development is related more to age or to the respective stage in the education system; that is, they allow us to ask if the competence level of a student is explained by the fact that he or she is of a certain age (say 15) or attends a certain grade (say 9) in school. The relationship between age and the stages of the education system may also change over the educational career and over historical time. However, cohort effects can be detected only if successive cohorts are observed over a longer period in the NEPS. For example, cohort effects could derive from the size of a birth cohort of students competing for a place at the Gymnasium or in the vocational education and training (VET) system, or they may be a consequence of specific educational reforms (the unification of Hauptschule and Realschule, for example). Some effects can also impact all students over a certain period of time, such as when the publication of the results of a large-scale student assessment study leads (temporarily) to greater effort on the behalf of students and teachers at all stages of education.

Review of Relevant Longitudinal Studies

Several longitudinal studies have already been carried out in Germany that broaden knowledge derived from cross-sectional studies by providing more information about causes of established competence developments and educational decisions. The available longitudinal studies can be assigned to the following four areas (cf. Table 1): (1) childhood development; (2) transitions and competence developments in elementary and secondary school; (3) transitions from school to vocational training and university; and (4) life-course research with a strong emphasis on educational and employment careers and family-related processes.

Childhood development studies (the first category of studies cited above) include national (DJI child panel) and regional longitudinal studies (BiKS, LOGIK) relating to competence and personality development in children and their transition from kindergarten to elementary school. The majority of longitudinal studies carried out con-

Table 1: Overview of German Longitudinal Studies Covering Education as a Research Theme

Area	Study title	Grade or age	Topic	Region	Year of first sampling	Year of final sampling
1. From kindergarten to elementary school	DJI (Deutsches Jugend Institut)-*Kinderpanel*	Children in kindergarten (5–6 years) and school (8–9 years) (Three waves)	• Determinants of psychosocial development of children • Risk factors for competence development	Germany	2002	2005
	BiKS-*Bildungsprozesse, Kompetenzentwicklungen und Selektionsentscheidungen im Vor- und Grundschulalter*	Cohort 1: 3–8 years Cohort 2: Grades 3,4,5,6,7 (8–12 years)	• Transition from kindergarten to elementary school • Transition from elementary to lower secondary school • Competence development, educational decisions and context effects • Domains: German language competencies, mathematical literacy, reasoning, meta-cognition, working memory	Bavaria, Hesse	2005 resp. 2006	Open
	LOGIK – *Longitudinalstudie zur Genese individueller Kompetenzen*	4 –13, 17, 23 years (12 waves)	• Developmental trends in cognitive competencies (reading, orthography, mathematics, science) and personality disposition	Munich	1984	2003
2. Elementary and secondary school	SCHOLASTIK – *Schul-organisierte Lernangebote und die Sozialisation von Talenten, Interessen und Kompetenzen*	Elementary school: Grades 1, 2, 3, 4	• Developmental trends in elementary school • Domains: mathematics, German language	Munich	1988	1991
	KILIA – *Kooperationsprojekt Identitäts- und Leistungsentwicklung im Anfangsunterricht*	Elementary school: Grades 1, 2, 3, 4	• Teacher study: importance of teacher when starting school • Student study: class climate and identity development	Nurem-berg	2000	2005
	KOALA-S – *Kompetenzaufbau und Laufbahnen im Schulsystem*	Grades 2, 3, 4	• Competence development (reading literacy, orthography, mathematics, cognitive abilities) and educational decisions in elementary school	Bavaria, Saxony	2005	2007
	BeLesen – *Berliner Längsschnittstudie zur Lesekompetenzentwicklung von Grundschulkindern*	Grades 1, 2, 3, 4	• Development of competencies (reading and writing, especially of children with migration background)	Berlin	2002	2006
	Schrift-Spracherwerb (Hanke)	Grades 1, 2 (partly Grade 4)	• Development of orthographic competencies • Teacher's pedagogical orientations ("open" vs. teacher-directed approach)	Cologne	1994	1998

Area	Study title	Grade or age	Topic	Region	Year of first sampling	Year of final sampling
	PERLE – *Persönlichkeits- und Leistungsentwicklung von Grundschulkindern*	Grades 1, 2	• Development of competencies (mathematics, acquisition of written language and the arts) • Personality traits	Saxony, Berlin, Thuringia, Brandenburg	2006	2008
	Hannoversche Grundschulstudie	Grades 2, 3, 4	• Development of competencies (mathematics, orthography, reading comprehension) • Personality traits (related to conditions in classroom and family)	Hanover	2000	2003
	MEPS – *Mannheimer Bildungspanel*	Grades 3, 4, 5, 6, 7, 8	• Competence development (verbal and mathematical competencies, reasoning) and educational decisions in elementary and secondary schools	Rhineland-Palatinate	2003	2008
	BIJU – *Bildungsverläufe und psychosoziale Entwicklung im Jugend- und jungen Erwachsenenalter*	Cohort 1: Grades 7, 10, 12 (13) voc. training/study/job Cohort 2: Grades 10, 12, voc. training/job/study	• Development of competencies (mathematics, English as a foreign language, science) • Psychosocial changes in youth and early childhood • Transition into the occupational/academic career	Mecklenburg-Western Pommerania, Saxony-Anhalt, North Rhine-Westphalia, Berlin,	1991 resp. 1993	2001 resp. 1998
	LAU – *Hamburger Lernausgangslagen-untersuchung*	Grades 5, 7, 9, 11, 13 (survey of complete cohorts)	• Transition from elementary to lower secondary school (retrospective) • School performance (reading, writing, mathematics) and problem-solving competence	Hamburg	School year 1996/1997	School year 2004/2005
	PALMA – *Projekt zur Analyse der Leistungsentwicklung in Mathematik*	Grades 5, 6, 7, 8, 9, 10 in general-education schools	• School performance in mathematics	Bavaria	2002	2007
	PISA-I-Plus	Grades 9 and 10 in the intermediate or in the academic-oriented track (different school types)	• School performance in mathematics and science	Germany	2003	2004
	KESS – *Kompetenzen und Einstellungen von Schülerinnen und Schülern*	Grades 4, 7, 8 (survey of complete cohorts)	• Transition from elementary to lower secondary school • Domains: mathematics, reading, writing, science, English • Children's, teachers', parents' attitudes	Hamburg	2003	Open
	ELEMENT – *Erhebung zum Lese- und Mathematik-verständnis*	Grades 4, 5, 6 in elementary school or *Gymnasium*	• Remaining in elementary school or moving on to the *Gymnasium* • Domains: reading, writing, mathematics	Berlin	2003	2005

Area	Study title	Grade or age	Topic	Region	Year of first sampling	Year of final sampling
3. From school to vocational training, university, and work	DJI – *Übergangspanel*	At the end of the lower school track (different school types)	• Transition into the vocational training system and into the less-qualified labor market	Germany	2004	2009
	HIS – *Studien-berechtigtenpanel*	Cohort of school-leavers entitled to higher education 1976, '78, '80, '83, '86, '90, '92, '94, '96, '99, 2002, '04, '05, '06 (up to 4 waves)	• Transition from upper secondary school to university or vocational training • Course of study or vocational training	Germany	1976	Open
	HIS – *Absolventenbefragung*	Cohort of higher education graduates 1989, 1993, 1997, 2001, 2005 (up to three waves, 1, 5 and 10 years after first degree)	• Course of study • Transition from university to the labor market • Employment, unemployment, further education	Germany	1989	Open
	TOSCA-2002 and TOSCA-Repeat – *Transformation des Sekundarschulsystems und akademische Karrieren*	Students graduating from vocational and general Gymnasium (three waves)	• Facets of the ability to study, mathematics, English as a foreign language • Transition into university/vocational training • Transition from upper secondary school to the labor market	Baden-Wuerttemberg	2002 and 2006	Open
	TOSCA 10	Students in Grade 10 (Realschule or Gymnasium)	• Transitions into apprenticeship and upper secondary school track • Competence development	Baden-Wuerttemberg	2007	Open
	ULME – *Untersuchungen der Leistungen, Motivation und Einstellungen zu Beginn der beruflichen Ausbildung* (continuation of LAU)	Students at beginning and end of vocational school	• Competence development during vocational school attendance • Domains: reading literacy, English literacy, job-related skills	Hamburg	2002	2005
	Lebensverlaufserhebung ehemaliger Gymnasiasten	Students in Grade 10 in *Gymnasium* (three waves)	• Socio-structural determinants of achievement in school • Study and vocational training • Employment	North Rhine-Westphalia	School year 1969/1970	1997
4. Education, profession, and family	GLHS – *German Life History Study*	Retrospective survey of selected birth cohorts (with one or two follow-ups for cohorts sampled in the 1990s)	• Changes in education, job entry, and the processes of starting a family	Germany	1983	2003
	SOEP – *Socio-economic Panel Study*	One survey cycle of households every year	• Broad range of topics	Germany	1984	Open

cern educational development within schools (Category 2). Among these regionally designed longitudinal studies, we can differentiate two types: the first concentrates on competence development within one level of education (SCHOLASTIK, BeLesen, and Hannoversche Grundschulstudie in elementary school and PALMA in the lower secondary school); the second predominantly examines transitions between two stages of education (BiKS in Bavaria and Hesse, KESS in Hamburg, Koala-S in Bavaria and Saxony). However, some studies have a strong focus on competence development as well as on transitions (ELEMENT in Berlin and BIJU in Mecklenburg-Western Pommerania, Saxony-Anhalt, North Rhine-Westphalia, and Berlin). Only two nationwide studies have a rudimentary longitudinal character – TIMSS 1995 and PISA 2003. TIMSS 1995 tested students in Grade 7 (1994) and one year later (1995). PISA 2003 has been expanded by a second wave (PISA-I-plus). Ninth graders from the intermediate and academically oriented tracks were tested one year later at Grade 10 in order to analyze how they had progressed in mathematics and sciences and what the determining factors were (Prenzel et al., 2006).

In respect of the third type of longitudinal study the institute HIS has conducted national longitudinal studies; however, no performance-based competence measurements were included. One of the HIS panels covers a cohort of school-leavers qualified for higher education. The panel follows the transition of these young people into university or vocational training and their subsequent educational career for a period of three and a half years after they have left school. The HIS graduates survey concentrates on the transition from university to the labor market and the further professional career. The DJI transition panel focuses on the transition of "disadvantaged" students who have finished the lower school track, and follows their paths into the vocational training system and their entry into the labor market (no competence tests have been conducted). There is also the ULME study in Hamburg that is testing competence development from the start to the end of a course at vocational school, independent of whether the vocational school is full- or part-time.

The fourth category of longitudinal studies differs from those previously summarized because of their focus on a longer time span. The study of former grammar school (Gymnasium) students' careers (starting at 10th grade) examines college and professional education as well as gainful employment in North Rhine-Westphalia over a period of 28 years. The German Life History Study (GLHS) collected data retrospectively from several birth cohorts on their previous educational and employment career as well as their family history in Germany. The GLHS does not include competence tests. Since the beginning of the 1990s, individual biographies of East Germans have been surveyed in order to obtain detailed information on lives before, during, and after the reunification of Germany. Finally, the SOEP, a general public survey carried out every year in Germany since 1984, includes large samples of West and East Germans as well as various groups of immigrants. The SOEP combines retrospective data on work- and family-related event history with prospective panel data on, amongst other areas, job and income mobility, educational participation, family status, and life satisfaction in different domains.

Other European and North American countries have a longer tradition of conducting educational panel studies that include the assessment of competencies, skills, and/or intelligence components. Roßbach and Weinert (2008) provide a summary of the most important longitudinal studies for preprimary education. Kristen, Römmer, Müller, and Kalter (2005) give an extensive overview of studies conducted in Canada, France, the Netherlands, Sweden, the United Kingdom, and the United States. In these countries, different approaches have been used to obtain longitudinal information on education. Most of the studies, however, are either long-running cohort studies that collect data on an individual's life over a long period or they are frequent short-term studies that cover a specific stage of the educational career.

In the United Kingdom, large birth-cohort studies focused on education have been carried out for half a century. The first, which started in 1958, was the National Child Development Study (NCDS). The British Cohort Study (BSC70) began in 1970; the Millennium Cohort Study (MCS) began in 2000/2001. While the distances between the panel points in the 1958 NCDS fluctuated between 4 and 10 years, the MCS has much smaller time spans, thereby permitting the collection of more detailed information on developmental processes and education. Data stem from a variety of traditional sources – children, parents, and schools – and various other sources, such as medical records. In addition, data are enriched with information from the micro-census.

In England and Wales, a prevalent research strategy is to focus on a short relevant sequence of the educational career. The Youth Cohort Study (YCS) is a repeated short panel study that provides insights into the transition from secondary school to further education and to the labor market. A new cohort has entered the study nearly every year since 1985. The sample members are normally interviewed at the end of compulsory education, at age 16, and are followed up to the ages of 17 and 18. In this study, only individuals are surveyed, and they are asked about their educational careers, grades, labor market experiences, and future plans.

Another variant of a cohort study focusing on careers after completion of compulsory education is the Canadian Youth in Transition Survey (YITS). This survey has been following students over a relatively longer period of time since 2000. The members of the first sub-sample were 15 years old; those of the second 18 to 20 years of age. For the younger cohorts, the only competencies tested were those within the framework of PISA 2000. Thus, high-quality competence measures were available for the base year (Statistics Canada & OECD, 2000). However, in the following years, no further competencies were assessed, so that only the decision on different forms of educational participation and the entry into the labor market can be observed. A similar strategy has been implemented by the Swiss Transitions from Education to Employment longitudinal study (TREE). This study also began in 2000 and measured competencies within the PISA framework but only for that year (Meyer, 2005).

A large number of different longitudinal education studies have been conducted in the United States. According to Kristen et al. (2005), "The most important large-

scale longitudinal studies on educational pathways are conducted by the National Center for Education Statistics" (p. 25). The main goals of these various studies are analyzing educational, professional, and personal development at different points in the educational careers and identifying the role played by personal, family, social, institutional, and cultural factors (National Center for Education Statistics, 2003a, 2003b).

Most of these cohort studies have four or five observation points, and start at Grade 10 or 12. They are thus high school studies, and their focus is on transitions to postsecondary education and the labor market. They include the National Longitudinal Study of the High School Class of 1972 (NLS-72), the National Education Longitudinal Study of 1988 (NELS-88), the Educational Longitudinal Study of 2002 (ELS), and High School and Beyond (HS&B). Some studies concentrate on students in tertiary education and their labor market entry. Two examples are the Beginning Postsecondary Students Longitudinal Study (BPS), and the Baccalaureate & Beyond (B&B). Recent years have seen the implementation of two cohort studies that focus on development at early ages. One cohort starts with the newborn; the other, with children attending kindergartens or preschools. Together, the studies are known as the Early Childhood Longitudinal Study (ECLS).

The situation for US education data can be described as additive, repeated cohort sampling. This means that the data are drawn from different cohorts of children and students at specific stages in the educational career. The complete data pattern of these cohorts delivers sequences reaching from birth up to the age of 30. However, a gap remains at the lower secondary level.

The Forthcoming National Educational Panel Study (NEPS) in Germany

Our short overview of available longitudinal studies conducted in Germany reveals that there is only one genuine nationwide panel study, the SOEP. Although this study includes no detailed data on changes in educational contexts or the development of domain-specific competencies, some measures on cognitive competencies and personality traits have been included in recent years (Lohmann, Spieß, Groh-Samberg, & Schupp, 2008).

Unfortunately, only limited conclusions can be drawn from the longitudinal studies in Germany that focus on measuring competencies. These studies either confine themselves to a certain region within Germany or concentrate primarily on one stage of education or a specific transition in the educational career. These studies make it impossible to understand how the competencies of individuals develop over the life course, how these competencies interact with educational decisions at various critical transitions in the individuals' careers, and how these competencies are influenced by the family and by the way teaching and learning processes are arranged in kindergarten, school, professional education, and university. These studies furthermore do not give us clarity on how competencies relate to the achieve-

ment of educational qualifications, and which competencies are responsible for labor market success and a successful private and social life. Thus, there is a huge demand for high-quality longitudinal educational research in Germany. In particular, there is a clear need for both analytical and methodological progress in order to understand educational pathways through the life course and how these lead to different outcomes. In short, a large National Educational Panel Study covering the whole life course is needed.

The basic design and organization of the NEPS derives from theoretical considerations and the institutional structure of the German education system.

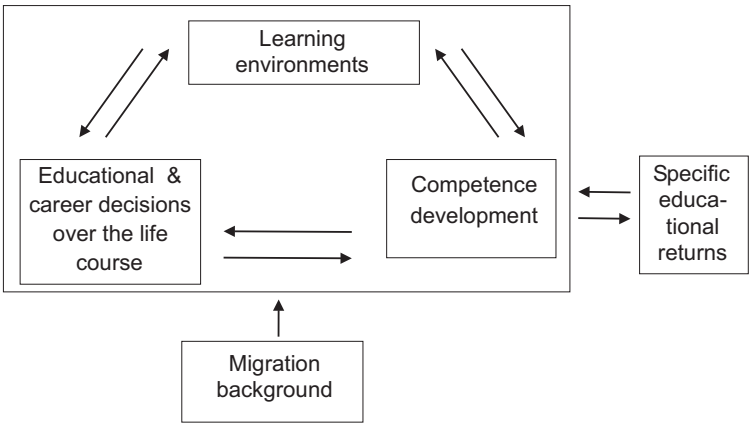
The Five Pillars of the NEPS

Because we concentrate in this article on the advantage of longitudinal data to analyze processes and on the sample design of the upcoming NEPS, we give only a very brief description of the theoretical background of the NEPS.

The preeminent theoretical orientation of the NEPS takes a life-course perspective. This orientation prompts a decided shift in how educational researchers traditionally approach issues of schooling, skills, competence, and attainment. In particular, it redirects attention toward the process of education and competence development, and it links the changing social structure to the unfolding of human lives. It also serves as a bridge between psychological and sociological perspectives and between individual development and social structure. Thus, the life course provides an excellent framework for studying education at the nexus of social pathways, developmental trajectories, and social change (Baltes, Staudinger, & Lindenberger, 1999; Diewald & Mayer, in press; Elder, Kirkpatrick, & Crosnoe, 2003).

The key theoretical assumptions of the NEPS as an instrument to study education over the life course can be best summarized diagrammatically. Figure 1 shows that individuals' educational trajectories over the life course are the result of a dynamic system, creating a complex, time-related interdependence of (1) educational decision-making, (2) educational processes within different learning environments, and (3) competence development. To amplify, decisions (by parents, students, teachers) determine whether and to what extent individuals participate in educationally relevant social and institutional contexts. Participation in formal, non-formal, and informal learning environments, in turn, influences further educational decision-making. Educational processes within learning environments supposedly influence competence development, which then influences future opportunities to participate in social and institutional contexts. Competence development also affects the processes associated with educational decision-making, while educational decisions influence future competence development over the life course. The focus within the NEPS on these three key theoretical dimensions and their time-dependent interaction mechanisms, which generate change and development over the life course, establishes a foundation for powerful explanations and evidence-based research.

Figure 1: Dynamic Interdependence of Educational Decision-making, Participation in Learning Environments, and Competence Development over the Life Course



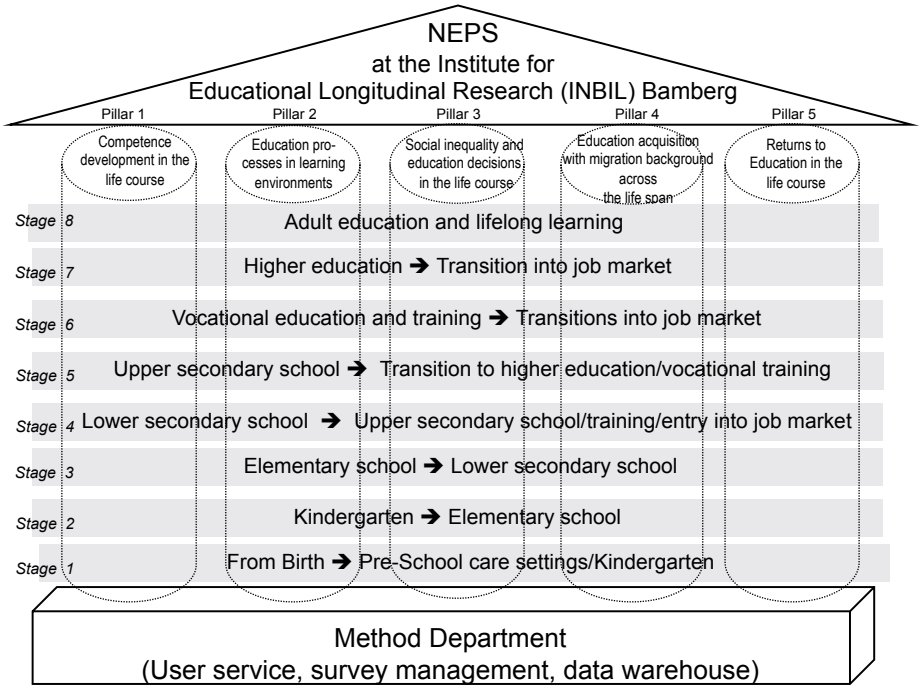
Another consideration of relevance here is the well-known fact that the educational outcomes of immigrants' children differ substantially from those of their peers from native families. These differences are likely to exist across the whole life course and follow very specific theoretical mechanisms. A fourth theoretical dimension of the NEPS is therefore concerned with the educational career of immigrants and their descendants. The NEPS will identify the particular mechanisms affecting the competence development and the educational decision processes of immigrants with a focus on the two largest groups of immigrants in Germany – Turks and ethnic Germans from the former Soviet Union ("Spätaussiedler").

Finally, a fifth important theoretical dimension of the NEPS concerns the issue of returns to education. The NEPS will thus focus on monetary and non-monetary returns to educational qualifications such as income, job opportunities, job careers, good health, reduced crime, increased political participation, stable families, and fertility behavior and homogamy. It will also consider subjective wellbeing over the life course. In particular, it will allow analysis of the monetary and non-monetary returns arising out of acquired cognitive and non-cognitive competencies and educational reforms.

In Figure 2, we label these five theoretical dimensions "pillars" because they will help us to integrate the proposed multi-cohort-sequence design of the NEPS in terms of content, theory, and method and provide a unified mold for the NEPS (Blossfeld et al., 2009).[4]

4 In addition, one expert group will take care of the most important methodological issues of the NEPS, such as sampling design, data cleaning, data archiving, data dissemination, and methodological analysis and training. Another expert group on technology-based assessment (TBA) will support the NEPS with respect to issues involved in computer- and internet-based assessments.

Figure 2: Theoretical Pillars and Educational Stages of the NEPS



The Multi-Cohort-Sequence Design

The above brief overview of longitudinal studies using different designs makes it clear that a long time is needed for birth cohort studies to present us with a "complete" picture of the educational career. Studying children's development and transitions until the end of the secondary school level would take nearly 20 years. Therefore, it is more efficient to concentrate on important sequences in the educational career.

The design of the NEPS covers eight educational stages:

1. The development of newborns and the transitions to preschool institutions/care settings;
2. Educational processes in the kindergarten and the transition to elementary school;
3. Processes in elementary school and the transition into the tracked secondary school system;
4. Processes in the lower secondary school and the transition to upper secondary school;
5. Processes of education in upper secondary school and the transition to university or vocational training;
6. Vocational and educational training and transitions into the labor market;

7. Educational processes at the tertiary level and the transition of graduates from universities and professional colleges into the labor market; and
8. Processes associated with all kinds of lifelong learning.

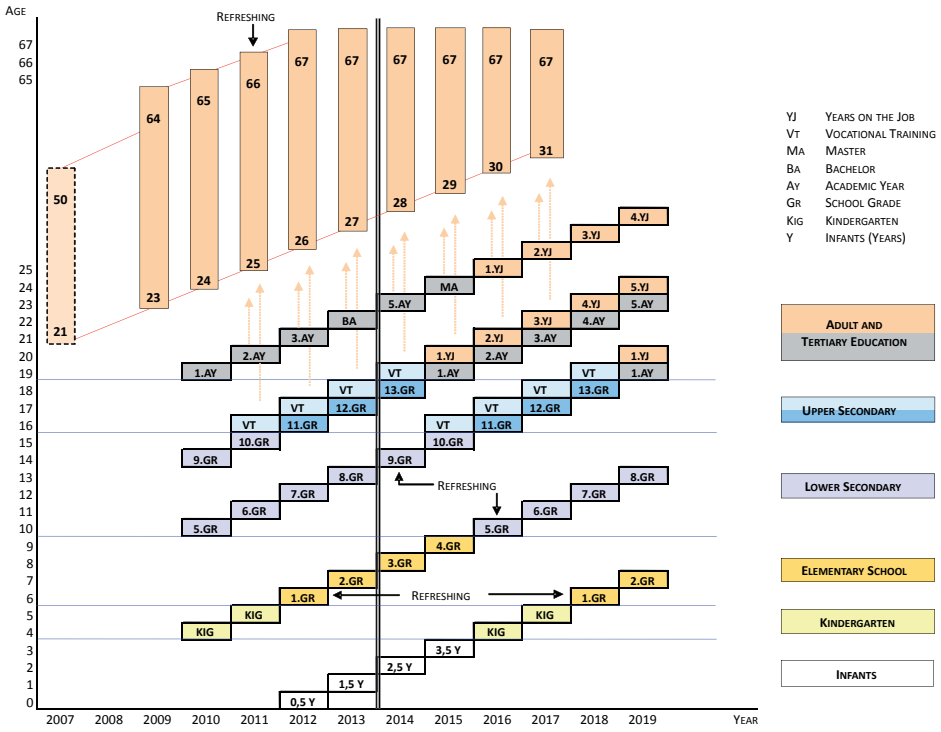
Samples must be drawn in a way that relevant information on every relevant sequence is quickly provided. The most useful design in this respect is the multi-cohort-sequence design.

Another area of particular concern is testing. Because individual competence tests are costly and time-consuming, the NEPS samples need to be based as far as possible on clusters of subjects. It is easier and more cost-efficient to conduct competence tests in larger organizational units such as kindergarten groups, school classes, and freshmen groups at selected fields of study at university. These clusters also allow multi-level analyses of educational processes. Thus, whenever possible, the NEPS preference will be for an institutionally based random sample of kindergartens, schools, and fields of study at universities and to follow up individuals within these contexts. Individuals who leave these contexts for any reason will be followed up individually over their respective educational careers and later life courses.

The three cohorts starting in kindergarten and school will be cluster samples. These permit analysis of structural and compositional context effects and reduce the costs of implementing the competence measurements and surveys. In subsequent years, all respondents will be followed up as far as possible in their institutional contexts. Students who remain in their original educational context will be tested yearly. Persons who leave the "standard" educational pathway will be followed up individually. An institution-based sampling is also planned for the higher education cohort, with study programs as clusters.

In essence, the NEPS will start with four parallel cohorts in the education system and follow them as long as possible. Study of the first wave of cohorts will begin in fall 2010 and then continue via yearly observations. As Figure 3 shows, the following cohorts are considered: The kindergarten cohort, which will later be enlarged during the first grade of elementary school to include children who did not attend kindergarten or have just moved in from other regions or countries, will be followed up in the class context by way of tests and surveys conducted throughout the years of elementary school and lower secondary school. The cohort of fifth graders will be followed up as far as possible in the school context by being tested and surveyed throughout the lower and upper levels of the secondary school. Once participants have chosen their vocational educational path and entered the job market, they will be followed up individually because the multitude of various institutions concerned, each with different organizational principles and time structures, will no longer allow assessment within classes. The cohort of ninth graders includes young people at the end of compulsory schooling. After the second measurement, this sample will separate into two sub-samples: the first one will contain individuals following the vocational track; the second, those attending advanced level secondary school (Gymnasium). The higher education cohort will be tested

Figure 3: The Multi-Cohort-Sequence Design of the NEPS



several times at university and then surveyed far into the stage of professional career (cf. Figure 3).

These cohorts will be complemented by two additional starting cohorts based on individual sampling: a cohort of newborns and their mothers starting in 2012 and a panel of adults (23- to 64-year-olds) starting in 2009. Because the vast majority of adults will have already left the formal institutions of the education system, we will be able to capture the various learning processes in adult life – processes that generally take place under very different circumstances. We intend to collect retrospective information at the beginning of the observation windows to provide a detailed picture of each individual's previous educational careers. In addition, important data on the individual's employer (e.g., size of firm and branch or business) can be linked using data from the Federal Employment Agency. Context data will thus be available for all sub-samples. We intend to follow up members of the individual samples yearly over time.

Additionally, up to the end of compulsory education, parents are also yearly surveyed by telephone interviews and in the case of the cohort of infants face-to-face. This approach will give us first-hand information on the children and their parents. Students' teachers and heads of kindergarten/schools will be surveyed, too.

Although Figure 3 displays the typical educational pathway of a cohort, it should not be taken as an implication that every individual will follow this pathway. For example, although most children start school at the age of six in Germany, some start earlier and others later. Moreover, most, but not all, children attend elementary school for four years. A look at the upper secondary and tertiary levels in the figure reveals even more variation. The beginnings of and time spent in the different forms of vocational education and training differ greatly in Germany, partly because school-leavers have different chances of obtaining an apprenticeship or entering a regular school-based VET-program. Considerable variation also exists among individuals relative to when they attain the general university entrance qualification, the "Abitur," and when they begin university. One reason for this is the requirement for young men in Germany to participate in basic military or alternative service. The individual times taken to complete university courses as well as the average institutionally determined durations of study also vary greatly. Moreover, many young people start vocational training right after the "Abitur" and enter university later or maybe never. However, in order to map where and at which point in time most members of a cohort may be in their educational career, we decided not to rely on age or the notion of "first, second, third, etcetera year after first observation."

We intend to draw new samples in subsequent years (cohort succession) so that we can study the influences of institutional reforms, labor market conditions, and social change on transition rates (e.g., transition into vocational education and training as a function of whether a desired VET program has become available, the consequences of Bundesländer-specific educational reforms, and so on). This strategy is comparable to that followed by the US-National Center for Education Statistics.

The major advantage of the NEPS is that it will allow collection of data on these kinds of processes over the entire life span. Another advantage is that competencies will be measured not only at the kindergarten and in school, but also in the vocational training system, at university, and after individuals have left the institutions of the education system.

Concluding Remarks

Given the rising importance of education as a lifelong process embracing all life domains, there is a huge demand in Germany for panel data and high-quality longitudinal educational research. In particular, there is a clear need for both analytical and methodological progress in order to enhance our understanding of the educational decisions that people make, the role that educational contexts play in determining the various educational and vocational pathways that people take, the role that these contexts play in people's competence development throughout the life course, and how these work together to produce different outcomes. Educational

participation and processes are embedded in various life-course-specific formal, non-formal, and informal learning environments, and they are influenced by specific historical times.

In this article, we focused on the methodological advantages of longitudinal data. Life-course research shows that results based on cross-sectional data have to be treated very cautiously. Therefore panel data are essential for making reliable conclusions. However, German longitudinal studies focusing on competence development or educational decisions are limited in several senses. Nearly all are regionally located, and nearly all concentrate on only one or two stages of the education system. The new National Educational Panel Study (NEPS) is designed to overcome these disadvantages. It is representative for Germany and starts at very specific points in the education system with different cohorts. The aim is to get as fast as possible relevant information in different educational stages and on the transitions in the educational systems. As individuals are yearly surveyed, by tests and questionnaires, panel data will be available. In addition, the previous educational history will be captured retrospectively. Another important advantage of the NEPS is that it will involve yearly surveying of kindergartens and full-time schools, so providing detailed information on the learning environment and offering points from which to analyze the influence of changes in these contexts on students.

In summary, the NEPS will facilitate description of the long-term development of education as a lifetime process on three dimensions: competence development, educational environment, and educational decision-making. The NEPS will also make it possible to study differences between various target groups, such as natives and individuals with migration backgrounds. In particular, we intend to oversample Turkish immigrants and ethnic Germans from the Former Soviet Union (Spätaussiedler). Finally, important forms of economic (i.e., job career, employment, income) and non-economic returns to education (health, family formation, reduced crime, political and social participation, and subjective well-being) will be considered and linked to the various educational pathways (Blossfeld et al., 2009).

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