Chapter 16
Dynamic Methods for Research in Education

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Education is concerned with initiating and attending to developmental processes, a highly dynamic subject matter. Therefore, research in education faces great challenges. The *methods* used in education research, however, frequently fail to take into consideration fully the very dimension of process and development. In many cases, the methods follow a research ideal informed by the natural sciences; often they are borrowed or derived from sciences such as astronomy, agricultural research, or classical physics (see Porter, 1986). There are great discrepancies between theoretical positions, the intrinsic dynamics of the examined phenomena, and the methods used which, in the main, support a static approach.

Methodology refers to the interrelationship which exist between theory, method, data and phenomena. In education research, however, not enough critical attention is given to this interrelationship and the specific methodological problems generated by its dynamic subject matter. The stereotypical application of the same unquestioned methods, time and again applied to investigate very diverse issues, limits much research activity. If the aim of education research is to do justice to education's dynamic subject matter—the processes of transformation and change which go on irreversibly in time—these very processes need to be reflected in research approach and method design (see Valsiner, 1994, p. 29).The aim of this chapter is to discuss the interrelationships of education phenomena, theoretical positions and methodological approaches in scientific education research.

The Methodology Cycle

In science, theories are formulated on the basis of what initially are mostly unsystematic observations which are critically examined through the application of research methods. Theories and methods are grounded in certain fundamental

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assumptions about the object under investigation and its context; they are often preconceptions or inexplicit and unexplained presuppositions. Branco and Valsiner (1997) discussed these relationships between the theoretical and empirical parts of the research process as a *methodology cycle*. Methodology is defined as concerned with the extensive interrelations and interdependencies of research object, theoretical assumptions, and empirical procedures involved in the research process and in contrast to *methods* (including the analysis of methods) which refers to the more narrowly defined issues of empirical data collection and processing, and problems that may arise therein.

Many controversies in psychology and the social sciences about paradigms and research strategies have arisen because of concerns about of methods rather than theories. Theoretical positions were assessed and judged not by debating their fundamental assumptions and presuppositions about the objects of investigations but whether they are compatible with the application of certain standard methods that are generally accepted to be valid. The result is "empirical hyperproductivity" (Valsiner, 2005, p. 7) matched by only modest progress in theory development. What is more, certain approaches and standards of method have become independently valid and dissociated from the theoretical and methodological contexts in which they originated so that the assumptions about research objects they implicitly entail are no longer critically taken into account or problematized in the research process. As Fassnacht (1995, p. 291) remarks:

> Modern scientific psychology is conceived first and foremost as the management of what is in principle already possible. The scholarly and competent employment of techniques, methods and knowledge for the purpose of answering specific questions: to understand what in principle has already been resolved, except that in relation to a specific, concrete question, the result is not yet known.

In the next section we outline the most important *fundamental assumptions* about education and discuss them with regard to their implications for methods.

Basic Assumptions About Education and Implications for Methods

Education can be defined as the intentional intervention into the development of persons who are growing up and includes changes in knowledge, ability and will (Krapp, Prenzel, & Weidenmann, 2006, p. 21). While *learning* refers rather to short-term changes, education is aimed at the long-term developmental processes of those being educated. The concept of socialization overlaps significantly with the concept of education. In socialization research the central question is how individuals grow up to become socially capable subjects and well adjusted members of social communities. While education research is focused on individual and interactive processes, socialization research is more concerned with social conditions and structures and examines their influence on those growing up.

Educators and the people they educate have a relationship, and one in which they are not symmetrically positioned. Educators strive to achieve positively valued change.

The determination of which educational goals are desirable is on the whole oriented toward the *normative ideas* of a particular culture, but education can easily find itself in a situation of conflicting aims. At the same time as education should accomplish the transmission of cultural achievements to children, they should also be formed into human beings who are capable of acting autonomously. Adaptation and autonomy stand in a relationship of tension, if not conflict. As Mitscherlich (1996, p. 27) points out:

> Education must fulfill an intrinsically dialectical function: education must provide for those being educated to practice the ways of society and simultaneously provide immunization against society whenever it tries to enforce the performance of stereotyped thought and action instead of critical reason.

While education aiming at adaptation and adjustment involves the strong, unilateral influence of adults onto children, education aiming at autonomy involves rather more indeterminate and open ideas about human development. Education may channel thinking, feeling and acting, but it also opens up *new horizons of the possible*. For example, the acquisition of cultural technologies such as reading and writing enable a child to absorb and pass on a multitude and variety of information as the child gradually develops from the instructed use of these technologies to using them autonomously.

Education also faces a paradox with regard to past, present and future. Education is supposed to prepare for the future, but the future is always uncertain and only partially familiar. Hence, Piaget calls for an open future orientation in education:

> The principle goal of education in the schools should be creating men and women who are capable of doing new things, not simply repeating what other generations have done; men and women who are creative, inventive, and discoverers, who can be critical and verify, and not accept, everything they are offered. (Piaget, 1988, Unpublished Paper)

From such programmatic position, education is not just about the transmission of a body of knowledge and of culturally based routines, but just as much about the transmission of flexible, general and generative problem solving strategies that are transferable into the future.

Although there is an asymmetric relationship between educators and those being educated, what goes on between them, education itself, is a reciprocal process and needs to be understood as such. Influence is not only exerted by educators onto those being educated, but the influence the latter have on their educators should not be underestimated. In the parental relationship, for example, babies change their parents' behavior as well as the social dynamic between them to a large extent. Parents constantly adjust their behavior to their children's new developmental stages and challenges. In general terms, the relationship between educators and those being educated is marked by a variety of *reciprocal interactions and mutual effects*.

Education as an Open Developmental Process

Education can be defined as processes of directed change which occur in time. Therefore, the concept of transformation is central for education, as it is for all developmental processes—over a period of time, X changes to Y. A project of dynamic

pedagogy, oriented towards development, needs to deal with these transformations: How does something new come about? What general regulating principles are at work? What general regulating principles govern transformations and change? What course do transformations in open systems take on time's irreversible arrow?

To what extent is it possible to predict developmental processes deterministically? Human beings are living, information processing, open systems. In contrast to non-living systems, they are in charge of their self-dynamic and have some autonomy which allows them to retain a degree of constancy in an ever changing environment. Von Foerster (1988) coined the term "non-trivial machine" for these kinds of systems. Changes in trivial (non-living) machines can be explained by the laws of cause and effect, but because of their self-dynamic, the behavior of non-trivial systems cannot be predicted deterministically. Even when educational processes produce the same or similar results, the actual developmental processes that take place with subjects (those being educated) and lead to these results may often be quite different. This equifinality is a defining feature of education. Sato et al. (2007) developed a model that allows for the representation of equifinality.

In this sense, education is a non-deterministic, open process. Concepts of circular systemic causality have been developed in dynamic systems theory which seem to be more suitable for the description of indeterminate developmental processes than simple, linear models of causality (see Valsiner, 1997, p. 38f). But the classic research designs of experiment and control group are also frequently used in education research and mostly involve simple causal models; for instance, when specific conditional factors are being isolated in order to come to a causal explanation for changes of particular characteristics that occur in students. One example (Helmke, 2003) of this kind of reasoning is the research question: Which characteristic features in teachers lead to a high level of performance in school children? Such an approach can expand in scope and address more complexity by using a multi-factorial or multi-level analysis, but the basic model of thought driving the approach remains the same, i.e., the search for predetermined or probable causal relation between two measurable factors.

The Aggregation of Data About Individuals: The Ideal of "l'homme moyen"

In traditional statistical analysis the first step is to aggregate data about different individuals. Averages, or mean values, and their respective mean variations are ascertained. Through such averaging, however, essential information is lost:

> Traditionally, the heart of statistical analysis in social psychology is averaging. (…) By averaging over time, one loses considerable information—perhaps the information that is most critical for understanding the phenomenon (Vallacher & Nowak, 1994, p. 289).

Statistical procedures that are based on estimates of true variance and error variance assume implicitly that the measured object does not naturally vary. This

assumption contradicts fundamental assumptions about education. It is precisely through educational processes that specific variations both among individuals and over time within individuals should be produced. The procedures for estimating error variance originated in astronomy (error law) where they describe the distribution of errors in repeated *measurements* of a particular object or event. Therefore, the term 'error' referred there not to the object being measured, but to the measurements and the procedures by which they were produced. The founder of social physics, Adolphe Quetelet, was fascinated by astronomy and transferred in 1836 the idea of the error law to *persons* by equating variance with error (see Wettstein, 2002). In Quetelet's eyes, deviation from the average generated not only ugly bodies but also ugly morals. Hence, he coined the term *l'homme moyen* or 'average man'. For Quetelet, this average man stood for the ideal human being:

> (…) an individual who epitomized in himself, at a given time, all the qualities of the average man, would represent at once all the greatness, beauty and goodness of that being (Quetelet, 1836, quoted in Porter, 1986, p. 102).

And

> (…) virtue consists in a just state of equilibrium, and all our qualities, in their greatest deviations from the mean, produce only vices. (Quetelet, 1853, quoted in Porter, 1986, p. 103).

Such view may seem like a bizarre anecdote, but a glance into many psychology journals shows that it is still a reality, even today. The individual with his/her individuality and the diversity among individuals are lost in these mean values. Especially for education, though, individuality is not some residual category, but it is "(…) a prime characteristic of human nature. To develop a science of personality we must accept this fact" (Allport, 1961, p. 21). Variability is a fundamental feature of all living things. Therefore, the examination of variability both within a system over time and between systems is critical to the understanding of developmental processes.

Aggregation over Time: Timeless Human Beings

In *cross-section studies* statements about the development of individuals cannot be made, but *longitudinal* studies allow, in principle at least, for the description of intra-individual changes, mostly across two measurement points relatively distant in time. This would, on a modest level, achieve the gathering of data on intra-individual changes. Hierarchical Lineal Models (HLM) (Raudenbush & Bryk, 2002) allow for measurements of change to be combined with a multi-level analysis. Estimates can be made about the influence of variables on different levels (e.g., individual, interactional, group, institution).

In education research, such input–output designs are mainly employed in the context of *school effectiveness paradigms* research, which is currently experiencing a golden age in the US and Europe (e.g., PISA, BIQUA). On the basis of large-scale studies "data-driven" decision making in education policy and thus higher

quality and increased effectiveness in education should become possible. This kind of research is designed according to a natural science paradigm (the isolation of central variables, technical control of confounding variables). In standard research the analysis proceeds almost without exception on a level of large aggregates, such as large groups, school districts or whole countries. The technique is also suitable for a status analysis, but it does not produce information about the developmental processes and mechanisms of individual students. Hence, after 20 years of standard research, Wayman and Stringfield (2006, p. 464) come to the conclusion that "(…) school systems are demanding more testing and measuring of students than at any time in history, but our educators often live in the paradoxical situation of being both 'data rich' and 'information poor'."

In order to understand developmental processes, phenomena have to be described in the form of 'thick descriptions'. From this perspective, the question in the foreground is no longer 'which educational systems lead to what kinds of outputs?', but rather 'which processes are going on in individual students and how can students be supported in their developmental and learning processes?'. Underlying this approach is an understanding of the course of development as non-linear. Development needs to be understood as a hierarchical process that shows discontinuities, ambivalences, and ruptures.

Different Temporal Resolutions

Depending on the observer's focus, reality can be partitioned into temporal units of different length. Likewise, educational processes can be investigated in different *temporal resolutions* and over different *periods of time*. The most common differentiations are micro-, meso, and macrogenetic perspectives (see Valsiner & Sato, 2006).

1. *Macrogenetic time perspective:* In macrosystems, often referred to as cultural systems, transformations take place over longer periods of time. Developments within a culture or sub-culture occur as socio-historical changes over decades or centuries.
2. *Mesogenetic time perspective*: This temporal perspective describes developments of the individual life course (ontogenesis): How do developmental transitions occur in an individual? The majority of studies in developmental psychology are concerned with this temporal level.
3. *Microgenetic time perspective:* A microgenetic perspective offers an analysis of relatively short time periods by operating with finely calibrated units of observations. In intrapsychic developments as well as in interactions, patterns may change within quite short time intervals (see Siegler & Crowley, 1991; Wagoner, 2009– in this book).

Microgenetic, ontogenetic, and socio-historic perspectives can be combined and investigated in parallel. The different temporal levels are in a relationship of mutual influence to each other. Thus, individuals develop through their participation in

cultural communities and at the same time, their active participation changes the cultural dynamic of a community (see Thommen & Wettstein, 2009, accepted). Which time perspective and temporal resolution is appropriate depends on the specific research question.

The process-oriented and dynamic view we have outlined largely contradicts *naïve theories of education and personality* (*common-sense psychology*). For the most part, these theories strongly rely on the idea of stable personality traits. Their danger when it comes to questions of education is that they tend to over-generalize undesirable behavior and that, as a result, blame is attributed to one side only, targeting particular persons. The stability of personality traits, however, exists first and foremost in our heads (Mischel, 1968). But because scientific theories often have some roots in everyday assumptions, a similar tendency can be noticed in the development of scientific theories. In both science and everyday life, two crucial qualities of human experience and behavior are rather underestimated: that they are processes and specific to particular situations.

Education in Social Context

Human beings do not act as isolated individuals furnished with particular personality traits or behavioral dispositions. Human beings always act in a material and social environment. Already Allport (1970, p. 172) pointed out that human behavior is dependent on context and the situation in which it occurs: "We never encounter personality apart from some situation." The variety of material and social environments leads to a great variability of forms of personal behavior.

The Ecological Perspective

Education takes place in diverse social contexts. An ecological perspective distinguishes the fields of family, school, and neighborhood. The degree to which education is institutionalized and formalized depends on the field or context in which it takes place. The highest degrees of institutionalization and formalization can be observed in a school setting. Schools set explicit learning goals and define the roles of educators and students. They organize learning by categorizing children according to specific rules into social groups and imparting to them a prescribed curriculum. Schools perform the functions of qualification, selection and legitimacy (see Fend, 1980) and to these ends, the education system has at its disposal diverse instruments of evaluation and sanction. By contrast, education within the family happens much less formally and is less goal oriented. But children acquire crucial competences in the areas of cultural knowledge and action by being part of a family system. To a large extent, learning in the family happens casually and accidentally (Bruner, 1971). From a socio-historical perspective, human beings develop as par-

ticipants in different cultural communities. “Humans develop through their changing participation in the socio-cultural activities of their communities, which also change” (Rogoff, 2003, p. 11). If one understands such social communities as open and transforming systems, however, education can be regarded as the exchange between individual and social systems (Thommen & Wettstein, 2009, accepted).

The central question for an ecological approach is how human beings behave and develop in their exchanges with their social and material environments (Barker, 1968). *Learning and teaching are context dependent processes*. Bronfenbrenner (1979, p. 21) defines the ecology of human development as

> (…) the progressive, mutual accommodation between an active growing human being and the changing properties of the immediate settings in which the developing person lives, as this process is affected by relations between these settings, and by the larger contexts in which the settings are embedded.

Issues of Cross-Situational Consistency

Cross-situational consistency refers to the behavior of a person across different situations. A person’s behavior is consistent across situations (cross-situationally), if the person acts similarly in comparable situations. For example — which types of behavior for which people are dependent on what kinds of situational conditions — could be examined. In his field study on the diagnostics of aggression in school settings, Wettstein (2006, 2008) identified problematic person-environment relationships which fostered or hindered the frequency in which individuals displayed aggressive behavior. These problematic person-environment relationships can be defined as if-then-relations, bearing in mind, however, that they are not thus defined as relations of cause or implication. For example: when in school excessive demands are made on student K, he displays in most instances physical aggression, directed against his own things (e.g., breaking his color pencils). Excessive demands on student F, however, lead to her displaying verbal aggression against female but not male adults. Shoda, Mischel, and Wright (1993) investigated cross-situational consistency of behavior over five types of situation among children attending a residential summer camp. They distinguished three negative (1–3) and two positive (4–5) types of situation: (1) being teased, provoked, or threatened by other children; (2) being put on notice by adults; (3) being punished by adults; (4) being praised by adults; (5) being approached socially by children of a similar age. They identified high rates of intraindividual consistency and intraindividually stable and distinctive ‘if-then’ profiles, with stability rates for verbal aggression of $r = 0.49$ to $r = 0.89$.

In sum, education, especially formal teaching in schools, consists not in the stereotypical application of specific techniques; rather, it is a complex *design profession* (Schön, 1983; Wiggins & McTighe, 1998). Teaching cannot be done by rigidly following a procedure; it demands the successful orchestration of diverse didactic and pedagogic strategies. Teachers’ professional knowledge is based on experience, oriented toward action, and organized to fit specific situations (Bromme, 1992; Leinhardt, 1993).

> In this context, the practitioner is less like the bulldozer driver carving a way trough the landscape to a pre conceived objective, more like a combination of canoeist shooting the rapids and creative artist exploring possibilities and waiting for inspiration (Radford, 2007, p. 275).

The consequence of such questions in cross-situational consistency for research methods is that the exchange processes among parts of a system become the central object of research. Rather than describing static traits of individuals, the aim is, then, to discover general patterns in the exchange processes among individuals or between individuals and their environment. Therefore, processes of communication and interaction move centre stage as the prime interest of scientific education research.

Education as Social Construction

Approaches in systems theory, in the sense of Cybernetics II (Glasersfeld, 1997; Maturana & Varela, 1987; von Foerster, 1984; Watzlawick, 2002), consistently set out with a process-oriented perspective. Here, operations going on in time, and not the properties of systems, are the central objects of research. The second basic presupposition of cybernetics II is the differentiation between system and environment instead of parts and whole (e.g., individual and social group) (Luhmann, 1995). According to this view, systems are structurally and functionally oriented toward an environment. Cross-border processes of energy and information exchange are going on between living, open systems (such as human beings) and their environment. It is only through the operations of a system that an environment appears as a unity, i.e., a system defines its environment and fixes its borders with it. For this reason, systems are inevitably self-referential. These premises—the distinction of system and environment and the presupposition that systems can only operate by self-referential processes—have wide ranging epistemological implications which have been the subject of intense debate and controversy, known as the *constructivism* debate (e.g., Luhmann, 2005b; Vollmer, 1995; von Foerster, 1981). The constructivist position is that a system that is capable of understanding makes a distinction between itself and its environment as it is in the process of perceiving and understanding; the distinction is a concomitant of the perception process. As a consequence, observers (and that includes the system as the observer of itself by way of self-reflection) always have to state precisely which system is operating and in the process of distinction making. An analytical differentiation of different observational levels is necessary: between a first-order observer making distinctions and a second-order observer who observes how another system makes distinctions. Scientific psychological understanding is fundamentally based on observations of the second order, because psychological research investigates objects (human beings, their minds, emotions, behaviors etc) that already act on the basis of perceptions, interpretations and reflections. In other words, investigations in psychology always deal with an already meaning processing object, i.e., human subjects or aspects of their being.

Social constructivist approaches presuppose that human beings attribute socially mediated meaning to their own as well as to others' behavior. Human beings do not primarily act as a direct response to physical stimuli, but on the grounds of social meanings that were imparted to them in the course of their socialization. Social meanings and the interpretations derived from them are more loosely defined and shared among people in smaller and larger social groups, institutions, or whole societies. Social meanings are the foundation for regular social interactions so that the behavioral expectations that those involved in interactions have of each other are more or less stable. At the same time, however, through social interactions social meanings are actualized, stabilized and handed down, as well as modified, transformed and changed (see Dykstra, 1996; Gergen, 1990, 1991, p. 241).

As a consequence, *research methods* have to include ways to record and analyze the interpretations that actors articulate when they attribute social meanings to their actions. This involves researchers approaching their research object in a hermeneutic process of understanding. As a first step, therefore, researchers have to reconstruct overt actions on the basis of understanding. This can be done from an *external position*: researchers interpret social action in a hermeneutic process against the background of explicit social knowledge (e.g., the already existing knowledge of researchers as members of social communities, or knowledge from different observations and sources such as documentation and analyses of patterns of interactions that correspond to ideal types or social norms). These interpretations form the building blocks for further analyses. At the same time, it is also possible to understand the research object through the *internal view* of those being studied when they disclose themselves to researchers. In this approach, research subjects are questioned about their general social knowledge or about their interpretations of specific situations and actions. The subjective statements that research subjects make establish a source of data for subsequent interpretations by researchers and for the development of theories.

Conclusions for Education Research

Researchers who conceptualize education as an open, socially constructed process face several challenges regarding the design of appropriate methods:

1. The research object is developing and changing in the course of time. Therefore, the use of time-sensitive research methods is required.
2. Education takes place in the context of an exchange with highly complex material and social environments, which are themselves developing dynamically. Of particular importance here are social communication and interaction. Therefore, methods are required that enable the production of data on system-environment interactions.
3. All those involved in the process of education attribute meanings to their own behavior as well as the behavior of all those with whom they interact. Children as much as adults are active constructors of their reality. Therefore, methods are required that document the social attribution of meaning.

Dynamic, Process-Oriented Methods

Education can be generally defined as the instigation of developmental processes that occur in time.

> Development then appears as a series of (…) changes that are joined together and that are to be assigned to specific places on the temporal continuum of an individual life course (Thomae, 1959, p. 10).

How can these developmental processes and transformation, constantly going on in time, be appropriately recorded and described? It is a challenging undertaking to demand that issues in scientific education research should be approached by using dynamic methods, by doing justice to the complexities of social environments, and at the same time by taking account of the social constructs of participants in their interactions. Only rarely can justice be done to all three requirements simultaneously. In this section we introduce research methods that, so we argue, do them justice at least partially. We distinguish two ideal types: *analytical-quantitative* and *reconstructive-hermeneutic approaches*. As we will show, however, these are not mutually exclusive categories and approaches from either type may be combined for specific research designs.

In *analytical-quantitative* procedures objects and methods are conceptualized in ways that are fundamentally orientated toward the natural sciences. In the case of behavior observations, distinctions regarding the examined object are made by means of a system of categories and indexes, and an underlying theory of measurement. Whether or not there is an event, and of what kind, is ascertained by observation. The result of such measurements is described by a predicate value. Behavioral events are assigned to categories in the same or analogous way as physical events are dealt with. The system of recording and codification and its coherence across different analysts serves as a criterion for the quality of objectivity of the recorded data. The interpretive processes, however, which occur when analysts assign events to particular categories (e.g., which behavior should be codified as "aggression with intent to damage") are not made specifically explicit and, consequently, they are also not problematized. In the case of psychological events and their codification, the scientists assigning codes inevitably fall back on their everyday knowledge and on information derived from context. The processes of categorization and of drawing final conclusions are usually not part of a methodical reflection in this research procedure. Coherence among different codifiers is deemed a sufficient device for achieving the objectivity of measurements. Each of the observed events and the codes resulting from them are regarded as independent empirical events. Subsequently, data can be further processed by statistical (mostly non-parametric) methods. If the temporal dimension is taken into consideration, the suitable mathematical-statistical methods are those based on time series analyses. Mathematical methods and models have been developed in synergetics (Haken & Schiepek, 2006) that enable the description and analysis of non-linear, dynamic processes.

Reconstructive-hermeneutic methods set out from a different conceptualization of what the object of research is and from different science-theoretical presuppositions. From this perspective the object of the social sciences is always and

already a socially constructed object. What human beings do or say, also in everyday life, has social sense and reflects social rules and conventions. Communicative processes and corresponding cognitive (e.g., linguistic) processes on an individual level are preconditioned by common systems of meaning, but at the same time, they serve to create, transmit and reproduce meaning and sense in social systems. According to this conceptualization, the social sciences fundamentally deal with phenomena of the origin and transmission of social sense and social meaning. In Schütz's words:

> The facts, data, and events with which the natural scientist has to deal are just facts, data, and events within his observational field but this field does not 'mean' anything to the molecules, atoms, and electrons therein.
> But the facts, events, and data before the social scientist are of an entirely different structure. His observational field, the social world, is not essentially structureless. It has a particular meaning and relevance structure for the human beings living, thinking, and acting therein. They have preselected and preinterpreted this world by a series of common-sense constructs of the reality of daily life, and it is these thought objects which determine their behavior, define the goal of their action, the means available for attaining them—in brief, which help them find their bearings within their natural and socio-cultural environment and to come to terms with it. The thought objects constructed by the social scientists refer to and are founded upon the thought objects constructed by the common-sense thought of man living his everyday life among his fellow-men. Thus, the constructs used by the social scientist are, so to speak, constructs of the second degree, namely constructs of the constructs made by the actors on the social scene, (…) (Schütz, 1971, p. 6).

Schütz's position corresponds with fundamental assumptions in the contemporary, constructivist systems theory. According to that theory, social science research deals essentially with second order observations, i.e., with constructs of the constructs made by ordinary people in everyday life, and at times even with third order observations, as when social scientists examine the constructs made by ordinary people about other people's constructs in everyday life (see Fleischer, 2005); for example, an investigation into the thoughts that ordinary people have about one another's cognitive constructs in every day life.

A social science methodology that ignores these fundamental anthropological assumptions will only be able to do limited justice to their research object. The consequences of presupposing a meaningful world for the conception of scientific methods are as follows:

1. The research process itself, i.e., the exchange between researchers and research subjects, needs to be understood as a communicative process. This applies also when the research is designed to keep the exchange as minimal and standardized as possible. Even when checking boxes in a questionnaire, for example, research subjects ask themselves about the researchers' expectations and what effects their responses might have; this is an instantiation of the well known phenomenon of compliance with what is socially desired (see Diriwächter, Valsiner, & Sauck, 2005). Therefore, techniques of data collection need to be regarded as social situations in which social meaning and sense are negotiated.
2. The empirical objects under study are, on principle, meaningful, be they non-verbal behavior, utterances or written statements. Researchers who want

to document and analyze them are forced to proceed through interpretation and understanding. For this reason, research in the social sciences may be regarded as the reconstruction (on the part of the researcher) of a reconstruction (made by the research subject). Expressed in systems-theoretical terms, these are observations of observations, that is observations of the second and third order (see von Foerster, 1981). For example, large amounts of data in the social sciences exist in the form of meaningful *narratives* (see Bruner, 1990). Research subjects tell or write down stories about events and experiences, about an episode or period in their lives, or their whole life history. Oral or written narratives, then, comprise the primary data material in the social science research.

Another, frequently applied method consists of researchers creating their own narratives about the phenomena under study. For example, Piaget (e.g., 1952) recorded his observations in the form of free descriptions as part of his *méthode clinique*. They served him in subsequent steps of abstraction to develop, illustrate, and empirically verify his theory of development. A problematic issue with this method is what the rules for the production of these kinds of texts are. The practice of their creation ranges from quite free narrative accounts to texts that have been constructed according to narrowly defined, precise protocols, and models.

In contrast to analytical categories, a significant feature of narratives is that a linguistic, either oral or textual, account of events can portray them in the temporal, sequential order in which they occurred. For that reason, narratives are an ideally suited (already meaningful) research material for the empirical analysis of developmental processes.

In science the aim is to reduce complexity and to search for general patterns and regularities as the basis for abstractions. This raises the question how research narratives can be further processed, whether those produced by ordinary people as research subjects or those produced by researchers. Many well known scientists (e.g., Piaget, Freud, Margaret Mead) used their narrative accounts of observations to provide case material and to develop, illustrate and verify their theories. Others strove to design methods that render a researcher's interpretation process more transparent, comprehensible, and therefore more open to critical evaluation. In the main, these researchers draw on the hermeneutic tradition. We specifically mention here the method of "objective hermeneutics" (Oevermann, 2001), the "documentary method" (Bohnsack, 2003, 2007) and methods of qualitative development of certain "types" (e.g., Kluge, 1999).

All these approaches have in common that they distance themselves from a particular position in the theory of science, as it is represented by critical rationalism (Popper, 1959), for instance. These approaches assume that scientists do not occupy a privileged epistemological position in relation to ordinary people. Scientists, too, have to follow certain rules when they devise new theoretical approaches and reinterpretations of social reality—rules which are negotiated within their 'scientific community'. This is also a position represented in the current debate on constructivism (Luhmann, 2005a,b).

Analytical-Quantitative Approaches

Two distinctive features characterize analytical-quantitative approaches as ideal types (see Fig. 16.1). (1) In a first step of data collection, empirical phenomena (e.g., physiological features, overt behavior, utterances, or written texts) are allocated to independent, analytical categories by means of decisions that are more or less inferential. (2) Data thus categorized are processed using mathematical analytical procedures (in the case of dynamic approaches using time-series analyses) for the purpose of identifying regularities and patters. In addition, data that are generated in this way can be compared to idealized mathematical models.

Analytical-quantitative dynamic approaches presuppose that system processes can, in principle, be formulated in mathematical form and that mathematical models are the optimal form for the representation and modeling of empirical phenomena. Dynamic systems theories, however, are not aligned with a mechanistic physical worldview, but with a physical worldview that has been developed, variously redeveloped and differentiated since the early 19th century (Kanitscheider, 1993).

Theories of Dynamic Systems—Synergetics

Dynamic systems theories (Vallacher & Nowak, 1994), especially synergetics (Haken, 1990; Haken & Schiepek, 2006), are rooted in physics. They deal with the self-organ-

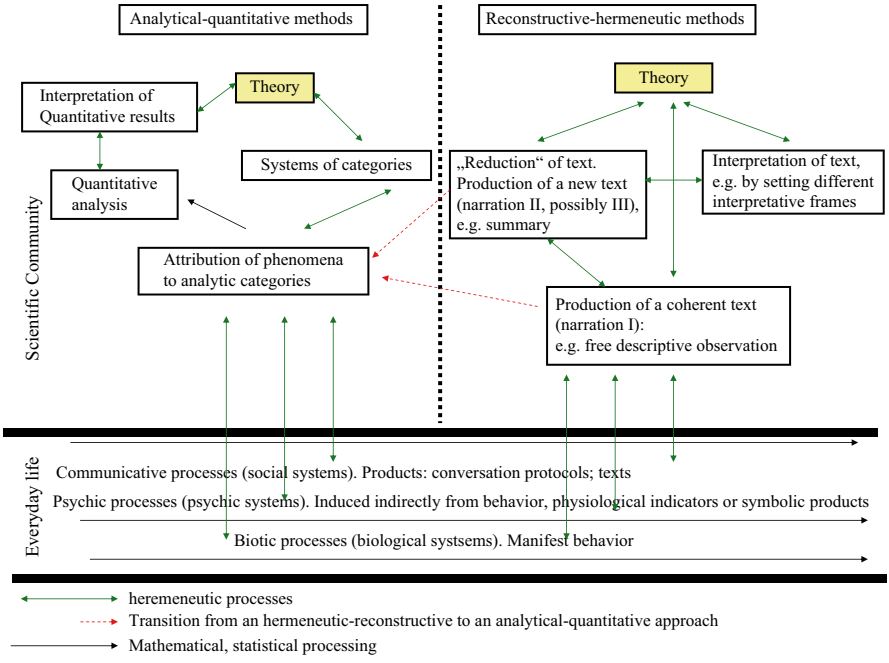

Fig. 16.1 Analytical-quantitative and reconstructive-hermeneutic methods

ization of systems and pay particular attention to the question how order develops out of disorder and chaos, but then changes and disintegrates again. Their premise is that physical systems, but particularly living systems, through continual processes of self-organization keep themselves in a dynamic state of balance in order to adapt as optimally as possible to their environment. The critical issue here is, however, how enduring and rigid such homeostatic states can be. If there is too much constancy, a system's capacity to adapt to a dynamically changing environment is lost, but if there is too much flexibility and capacity for change a system is in danger of loosing its identity. Living systems usually oscillate between constancy and change in a dynamic equilibrium, a homeodynamic stability (Haken & Schiepek, 2006, p. 27). Synergetics was initially developed in relation to processes in physics and chemistry (Haken, 1990), but it is nowadays frequently applied to psychic and social systems (Haken & Schiepek, 2006; Vallacher & Nowak, 1994). Transformational and change processes do not always proceed on a continuous and linear course; rather, there is often evidence of qualitative ruptures and transitions linked to chaotic developments.

The study of self-organization has predecessors in the history of psychology, mainly in the field of studies on perception, thought and behavior. *Gestalt*-psychologists in particular, e.g., Köhler (1973) and Metzger (1986), worked on psychic processes of self-organization in the area of perception, thought and action. As a result, questions about how external influences impact on the behavior of human beings were of greater interest to psychologists. Processes of self-organization and questions about how ordered patterns form and take shape were relegated to the background. For the following reasons, however, synergetic concepts and methods are of special interest to developmental psychology:

1. Systems theory approaches have become widely accepted in psychology. As psychology is concerned with individual systems, and in the case of social psychology with social systems, emotional, cognitive, motivational, behavioral as well as communicative processes are central issues in the discipline. Synergetics provides a theoretical and methodical framework for the description of these dynamical processes.
2. When dealing with processes of learning, development and education, a critical issue is how various forms of structures are generated and changed in open, complex systems. Synergetics provides approaches for understanding how systems develop new qualities (*emergence*). In psychology development has been mostly regarded as a sequence of qualitatively distinct phases, though without there being adequate means and models of description.
3. Concepts central to the theory of dynamic systems and corresponding mathematical formulations—such as 'circular causality', 'attractor', or 'order parameter'—promise an improvement over standard mathematical models for the description of processes and patterns in psychic and social systems (see Haken & Schiepek, 2006).

The links between synergetics and education are yet scant. An examination of contributions to a 1997 symposium on "Self-Organization in Psychology" reveals that none of them addresses issues in pedagogy or education (Tschacher, 1997, p. 15). Likewise, relevant general reference books on synergetics do not index edu-

cation, teaching, or pedagogy, and not a single study in this area is listed (Haken & Schiepek, 2006). Considering the nature of education, it is astounding that the models and approaches from dynamic systems theory have not been applied so far in research on learning processes or communication and interaction in school settings. Similarly, there are no empirical studies examining the interaction of teachers and pupils. One reason for this lack may be the sheer complexity of these interactive events: that there are more members in a school class than in a therapeutic dyad and, consequently, the processes going on in such a research setting are significantly more diverse and complex, and hence more difficult to record and document.

In Haken and Schiepek (2006) a whole chapter is devoted to processes of self-organization in social systems in which questions of communication and social coupling as well as phenomena of group dynamics are examined. Synergetic approaches have variously been adopted also in developmental psychology (van Geert, 1998), psychotherapy research (Tschacher, Scheier, & Grawe, 1998), research on interaction between spouses (Gottman, Murray, Swanson, Tyson, & Swanson, 2005) as well as research on the family (van Geert & Lichtwarck-Aschoff, 2005).

> A dynamical view of social processes focuses attention on the temporal patterning of interaction instead of on a static view of social events. This point of view can only enhance interest in what actually occurs in social interaction and how this interaction is perceived (Gottman et al., 2005, p. 66).

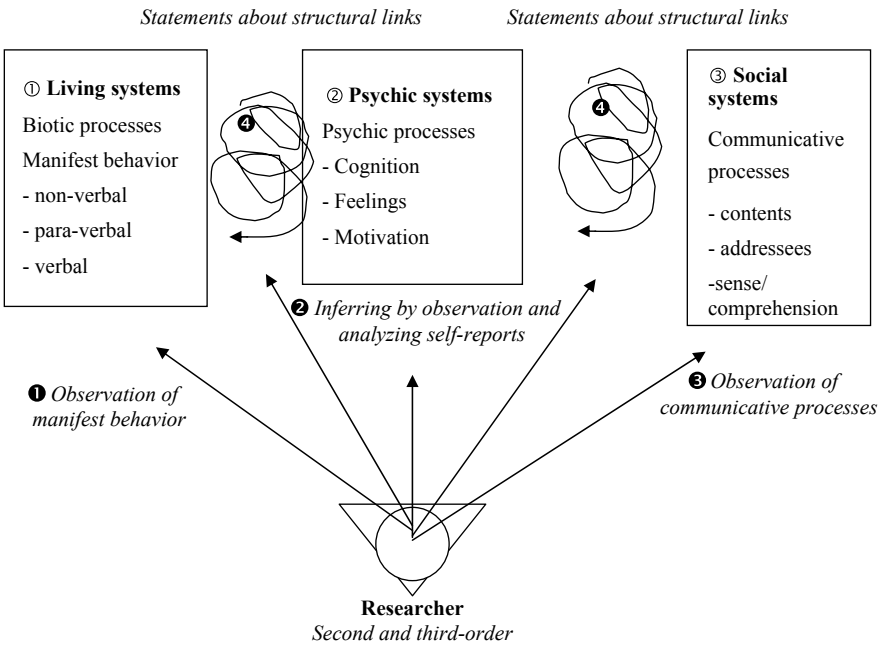

Fig. 16.2 System processes and methodological approaches, ① bio-physiological und motor processes (especially behavior) of students and teachers. ② psychic processes of students and teachers (cognitions, feelings, motivations). ③ communicative processes in the social system of the school class, i.e., among students as well as between teachers and students

We, the authors, are currently involved in an ongoing project of empirical education research (*Projekt zur Untersuchung der Entwicklung und Veränderung von Unterrichtsstörungen in Schulklassen*—An Investigation into the Development and Transformation of Lesson Disruptions in School Class Settings) for which we adapt fundamental premises and concepts of dynamic systems theory and corresponding methodological approaches to this context (Wettstein & Thommen, 2006). A particular focus is the mutual influence that intrapsychic processes in individual pupils and social interactions have in the system of a school-class. Such a process orientated and systemic-constructivist perspective expands the more prevalent dispositional and individual-centered perspectives on teaching disruptions or disruptive behavior. In our project we conceptualize disruptions during lessons as co-evolutionary processes between bio-physiological, psychic, and communicative processes in the social system of the school class (Thommen & Wettstein, 2009, accepted). Within this systemic-constructivist framework we distinguish processes of three qualitatively different types of system (Fig. 16.2).

Formulated in the terms of systems theory, the issues investigated in our project are (see Fig. 16.2):

❶ What processes, especially behavior processes, are going on at the level of the *living systems* 'teacher' and 'student? What behavioral patterns can be identified?

❷ What cognitive, emotional, and motivational processes are going on at the level of the *psychic systems* 'student' and 'teacher'? What intrapsychic patterns can be identified?

❸ What communicative processes are going on at the level of the social system 'school class'? What communicative patterns can be identified?

❹ How do the processes at the individual and the social levels *co-evolve*? Are they structurally linked? What superordinate patterns can be identified in the ways in which processes unfold in each of the systems?

Dynamic systems theory so far has been primarily concerned with the description and simulation of linear and non-linear time series of single process variables. If classroom disruptions are conceptualized as a co-evolutionary process of intraindividual (bio-physical or psychic) and interindividual processes (social-communicative), there are methodological consequences: data of the two simultaneously running processes should be related, so that regularities and patterns of the co-evolutionary process can be investigated. We do not know any mathematical models that achieve this. There are, however, ways of representing and illustrating patterns of parallel occurring processes in analogue form, as graphic representations.

Choreographies and Orchestral Scores

Systemic-constructivist approaches make the fundamental assumption that there are dynamic processes going on simultaneously in systems and their environments. Music and its graphic representation in sheet music or whole orchestral scores provides a fitting metaphor of this perspective. Individual instruments and their musical parts correspond to ongoing processes of individual systems. Regularities in the

orchestral score can be analyzed both vertically (as harmonies at a particular bar or beat) and horizontally (melody and themes). In temporally synchronized accords and harmonies of each melodic arch, the parts of individual instruments co-evolve to a complex, highly structured, and ordered (and in the case of Mozart, for example, certainly well-pleasing) acoustic event.

Vorsmann (1972, p. 43), prefiguring such ideas decades ago, coined the term "*Unterrichtspartitur*" ('teaching lesson score'). As an alternative to teaching research based on input–output models and testing established hypotheses primarily from aggregated data, he suggested the analysis of single case studies. Instead of analyzing single variables, these case studies allow for the description and analysis of the complex processes that are going on during a lesson. Because his reflections were primarily aimed at practical issues in teacher training and professional development, he developed systems of observation and description that practitioners could use for evaluating and improving teaching delivery and lesson design. He succeeded in recording the simultaneously occurring behaviors of teachers and students using tables and graphics, and in them also managed to integrate the methodical and didactical arrangements of lessons which unfold at the same time. Given the technical possibilities available at the time, he did not formalize his technique any further.

In order to put the perspectives of learners and their learning processes centre stage of reflections on didactics, a group of researchers around Oser (Elsässer, 2000; Oser & Patry, 1994; Oser & Baeriswyl, 2001) developed an approach to *choreographies of learning in formal teaching settings*.

> We postulate (…) the hypothesis that at the base of all learning there is a so-called choreography, or that learning should have a base in choreography, that combines both the freedom to orchestrate methods and the rigidity of absolutely necessary steps of learning. Our hypothesis is part of a comprehensive theory of learning which occurs as a process and under conditions in which chaining [of events], forms of actions and proximal interconnections are all relevant to the course this process takes. (Oser & Patry, 1990, p. 1).

Oser and Patry distinguished between manifest structures and base structures. Manifest structures refer to the observable behavior of learners and the observable interactions between teacher and learner. These various manifest structures are founded in base structures of teaching-learning processes, described as ideal types.

> The base structure consists of a fixed chain of operations that is absolutely necessary for every learner and that cannot be substituted by anything else. The holistic character of each chain is determined by regularities in the psychology of learning as well as by the type of goal or the contents. (Oser & Patry, 1990, p. 3).

Oser and Patry's theoretical reflections are primarily concerned with different learning types, but they also derived twelve basic models of learning. They used the construct of choreography to refer to the process character of what happens in teaching-learning events. But they did not generate their basic models empirically, nor did they render them useful for the analysis of visible structures. The basic models were normatively posited and initiated the following research questions, among others: Which basic models do teachers use in their teaching? Does the teaching of basic models to teachers contribute to an increase in the quality of their teaching?

By proposing the concept of choreography Oser and Patry offer an interesting construct for the description of dynamical processes involved in teaching and formal instruction. The theoretical postulates of temporality and simultaneity, however, are in their empirical work only partially fulfilled.

In teaching research the concept of *scripts* is significant, especially in the *investigation of teaching-learning processes*. The concept was originally developed in cognition research, but it shares many similarities with the constructs 'choreography' or 'orchestration'. Schank and Abelson (1977, p. 41) defined script as "… a predetermined, stereotyped sequence of actions that defines a well-known situation." In a variety of video studies on mathematics teaching (Pauli & Reusser, 2003) and physics teaching (Seidel, 2003; Seidel et al., 2002) the concept of scripts has been closely examined, e.g., whether teachers realize certain scripts, how great the variability of scripts is, and whether scripts are linked to students' motivational and cognitive proc-

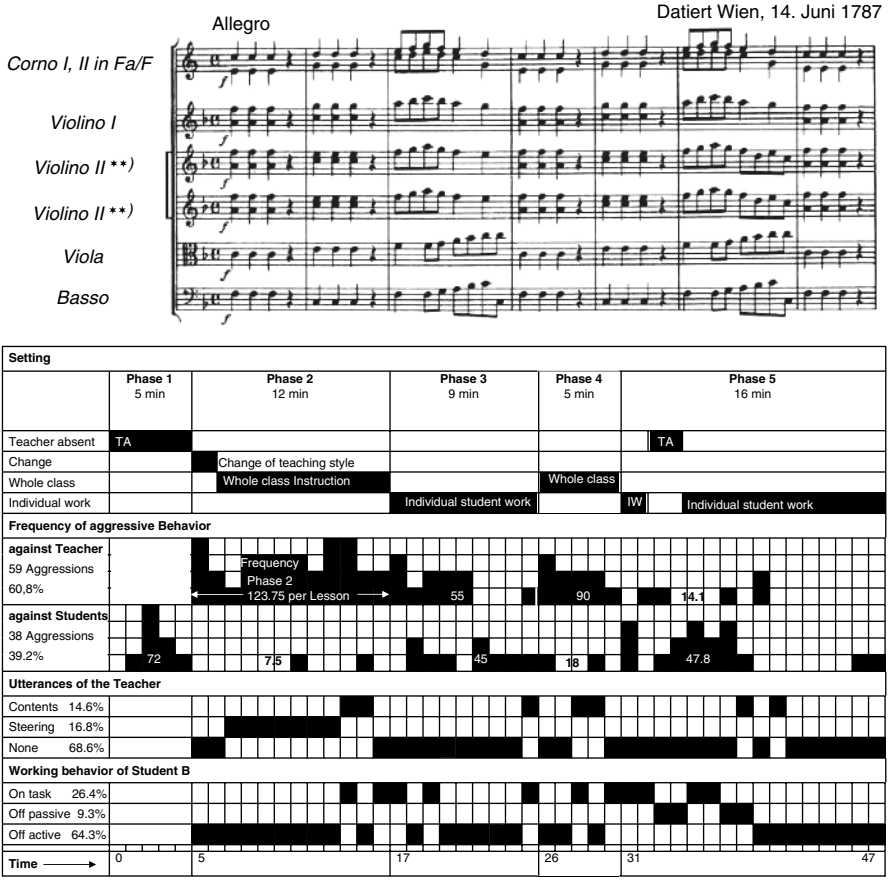

Fig. 16.3 Excerpt from Wolfgang Amadeus Mozart (1976) *Ein musikalischer Spass* (A Musical Joke) for two horns, first violin, second violin, viola, and cello, showing his experiment in multi-tonality; and teaching lesson score showing a temporally ordered data set with four observational dimensions

esses. Lesson sequences were identified by applying mostly relatively wide-ranging, general categories (e.g., lesson phases like whole class instruction, individual quiet work, working in groups, repetition of lesson content, or learning of new content). The concept of scripts, however, calls for a specific kind of analysis of empirical data, namely a sequential analysis, and these empirical studies only partially performed such an analysis. Often, the categorical data were aggregated already in the initial stage of statistical processing, and it was these aggregates that were subsequently analyzed for correlations. Seidel (2003, p. 174) herself, then, critically remarks on her empirical analysis: "But as a consequence of the high level of aggregation in this method, the process character of the in-class observations largely gets lost." She concludes by calling for detailed case studies about how lessons unfold and progress in time and the interactive teaching-learning processes involved.

Reconstructive-Hermeneutic Methods

It is a defining feature of reconstructive-hermeneutic methods that researchers do not allocate data to analytical categories immediately as they are recorded, but that they record them in narrative form or, as it were, reconstruct them. Narratives offer a whole range of advantages in relation to our main concern, i.e., a process orientated representation of data. In a narrative account, the temporal sequence of events can be linguistically represented. It can be stated in what sequence events occurred, which event occurs before another, or what relations of past, present, and future events have with one another. Also features such as complex temporal embeddedness or encapsulation and different temporal grades of resolution can all be expressed by the means of language.

The first step of data analysis in reconstructive-hermeneutic approaches is that the researcher produces a narrative. The initial data for the construction of this narrative may be individual verbal or non-verbal behavior, or they may be narratives already created by research subjects (descriptions of and stories about experiences in the form of verbal accounts or written texts) as they are commonly elicited through questionnaires that include open questions or through narrative and semi-structured interviews. In such cases, research subjects already constructed descriptions about themselves on the basis of which researchers create their narratives. This means that researchers construct narratives about narratives, double constructions, in other words, or observations of the third order.

Narratives can be strongly subjective, or they may have been crafted under comprehensive methodical control and are thus more transparent as creations and intersubjectively comprehensible. In a hermeneutic tradition several methods have been developed to make explicit the understanding of narratives, among others objective hermeneutics (Oevermann, 2001) and the documentary method (Bohnsack, 1997, 2003, 2007; Vogd, 2005). In the American tradition, ethnomethodological approaches (Garfinkel, 1967; Spindler & Hammond, 2006) and frame analysis (Goffman, 1986) should be mentioned.

The Description of Verbal and Non-Verbal Behavior in Natural Settings

In order to find out how human beings behave in their daily lives, observations have to be made in everyday life settings, as far as this is possible. There is a vast and rich repertoire of methods in social and cultural anthropology, detailing ways in which, mainly through participant observation, thick descriptions of individual and social processes can be produced in natural cultural settings (Geertz, 2006; Mead, 1930; Whiting & Whiting, 1975). Psychologists partially draw on these models, but there are important contributions developed within psychology which rely primarily on naturalistic observations.

Piaget's *research* is largely based on his observations of children's behavior in natural settings. He supported his theory on the origin of intelligence in the child (Piaget, 1952) with observations and descriptions of his own children's behavior. He deduced his pioneering theory of cognitive development from these behavioral observations and developed two central concepts: the processes of assimilation and accommodation. At the same time, his empirical observations also underpinned the development and verification of his models of cognitive development. For all of his life, Piaget disassociated himself from narrowly defined, quantitative-experimental methods in psychology.

> The good experimenter must, in fact, unite two often incompatible qualities; he must know how to observe, that is to say, to let the child talk freely, without ever checking or side-tracking his utterance, and at the same time he must constantly be alert for something definite; at every moment he must have some working hypothesis, some theory, true or false, which he is seeking to check. When students begin they either suggest to the child all they hope to find, or they suggest nothing at all, because they are not on the look-out for anything, in which case, to be sure, they will never find anything (Piaget, 1981, p. 19).

Barker and Wright (1955, p. 2), however, offered the criticism that unlike geologists, biologists, chemical engineers, and physicists who know with considerable detail the natural distribution of objects and processes that are their subject matter, psychologists know little about such things as how a mother takes care of her child or how a teacher behaves in her/his class room. In *One Boy's Day* Barker and Wright (1951) applied a natural history approach to investigate the "stream of behavior" of a boy in the natural context and over the whole course of the boy's day, from his getting up in the morning to his going to sleep at night. A team of trained observers followed and recorded all aspects of daily life of the 7-year-old child without interruption and divided the boy's stream of behavior into behavior episodes. On the basis of a subsequent study, Barker made the following observation

> The characteristics of the behavior of a child often changed dramatically when he moved from one region to another"; and: "The behavior of different children within the same region was often more similar than the behavior of any of them in different regions (Barker, 1968, p. 152).

So, in a bakery, for example, children behave in ways that fulfill the conditions of being in a bakery or when sitting in school class the conditions of attending les-

sons. Lichtenberg (2003) replicated the study by making a digital video recording and analyzing the daily routine of a mother with her small child in a big city.

The research team around Krappmann (Benkmann, 1987; Krappmann & Oswald, 1995; Schrenk & Krappmann, 2005) studied *the everyday life of school children* through participant observation and recorded their observations in episodic descriptions and protocols of the course of events. Her assumption is that any problematic behavior displayed by an individual should not be regarded in isolation. Aggressive behavior, for example, must be investigated in the social context in which it occurs and in terms of its functional value. In their study among 10-year-olds about the functionality of using violence in their daily life at school, Oswald and Krappmann (2000) reach the following conclusions:

> Here and everywhere and before long educational interventions are not effective, because they disregard the functionality of the use of violence in the interactive processes of the children's world. This world is a social world in which children need to try to achieve the goals that are of primary importance to them by making economical use of whatever means are at their disposal. (Oswald & Krappmann, 2000, p. 14).

Following theories of the pragmatic philosophy of language (Habermas, 2006; Searle, 1969; Wittgenstein, 1953), the events taking place in a class room can be regarded as a language game which can be examined by means of a *micro-dialogue-analysis*. Methods developed in social and cultural anthropology (e.g., Erickson, 1987; Hammond, 2006), among others, are suitable for the analysis of such processes of co-construction. The verbal contributions of communication partners are analyzed and interpreted in the temporal sequence in which they occur. Krummheuer (1997) and Krummheuer & Naujok (1999) carried out micro-sociological studies of teacher-student interactions as well as interactions among students in mathematics lessons, drawing on Bruner's (1983, p. 120f.) concept of "format". Bruner defined "format" as a "standardized, initially microcosmic interaction pattern between an adult and an infant that contains demarcated roles that eventually become reversible" (Bruner, 1983, p. 120). In addition Krummheuer refers to Erickson's (1982) "academic task structure" (ATS) and "social participation structure" (SPS) that form the basis of these interactions. The aim of this empirical research methodology is threefold: to understand the social construction of what goes on during lessons through context specific interpretations; to test the plausibility of ex-post-facto-hypotheses determined by abduction (Peirce, 1978) through empirical analysis; and to make transparent the theoretical knowledge and presuppositions, on which the analysis is based. Lüders (2003), following a comparable methodical procedure, analyzed the structuring of lessons into teaching phases and free student contributions.

The question at the core of such research is: how do teachers and students together co-construct meaning and social knowledge in the course of their communications during lessons? Maciel, Branco, and Valsiner (2004) examined conversations between teachers and students and showed how in the process of their communication and meta-communication they simultaneously built mutual trust in their relationship and reciprocally steered the teaching-learning process.

> The microgenetic analysis of episodes of transitions in the teaching/learning process may prove an adequate route to highlight the differential role played by specific strategies as

> well as a means to unravel the organization of the processes at both structural and dynamic levels. (Maciel et al., 2004, p. 123).

The theoretical paradigm for such micro-analyses consistently is understanding. Empirical studies show how participants in interactions generate social meaning specific to the context and which general social rules and conventions are the basis for these interactions. However, such studies rarely produce findings that are generally applicable across other contexts. For this reason, their conclusions are of limited relevance to issues in practical pedagogy.

How do schoolchildren shape the transition between recess and lesson? Which rituals are part of this transition? Wagner-Willi (2005) takes up approaches established in social and cultural anthropology, such as *ritual studies* (Turner, 1989) and theories of cultural performance (Geertz, 2006), as well as Goffman's (1986) theory of frames. She points to interesting issues about the relationship of the socially normative form of rituals and actors' actual and creative performance. Wagner-Willy made video recordings of the transitions between recesses and lessons, and analyzed these scenes by means of documentary interpretation (Bohnsack, 1997, 2003, 2007). In a documentary interpretation approach, the empirical material (here the video recordings) is processed in three steps in order to establish the formal organizational structure of interactions. In a first step, called *formulating interpretation*, a description of the recorded behavior is formulated with as little inference as possible and without attributing motives to actors. The second step, *reflecting interpretation*, aims at a theoretical-reflective explication of the observed interactions that all refer to each other. The final, third step, *comparative interpretation*, consists of comparative interpretations with reference to different theoretical systems. Because of these transparent and explicitly stated comparative interpretations a decision can be made as to which frame of reference is best suited to the reconstruction of the empirical material. The documentary method consistently addresses a main concern of reconstructive-hermeneutic methodologies which is to understand the complex reality of interactions from multiple perspectives and in terms of their intrinsic form as processes and their interconnected meaning.

The Description of Narratives

Psychology deals to a large extent with self-accounts rather than with direct observations of verbal and non-verbal behavior in natural settings. The empirical research material most often consists of narrative products of oral or written form in which research subjects provide accounts about themselves or about events and experiences of the more or less distant past. Self-accounts provide insights into the subjective processes of construction by which people subjectively represent and construe their reality (e.g., life history research). It is important, however, not to confuse subjective representations with actual actions and experiences, as they occurred at the time. Such self-accounts primarily convey how people would like to see themselves

and not what they in fact did and do. Self-accounts are based on memory, and they are therefore the result of subjective corrections and distortions.

Schrenk and Krappmann (2005) investigated whether students make use of aggressive strategies in order to reach their personal goals. They presented primary students with a fictitious case, a "vignette", and asked them what their tactics to resolve a social problem would be, in the case below, to achieve the desired participation.

> Monika (…) is sitting together with Britta (…) at a table for six. Britta is very popular, for there is always something happening around her. Everybody likes her and likes being near her. In today's German lesson they are engaged in group work. At each table of six students should make up a story together. Monika instantly has a great idea what they could write about. But the others push the piece of paper towards Britta who immediately begins to write down a story. Monika calls out: "I know a fantastic beginning for the story!" But the others do not listen to her. (Schrenk & Krappmann, 2005, p. 26).

After reading the case story, the children produced their solutions for how they would deal with the social problem and the researchers analyzed them. Schrenk and Krappmann concluded that much of the aggressive behavior involves tactics that children develop on the basis of their social experience and that they often use quite competently. In many cases these tactics signal elaborate experiential knowledge and pragmatic calculation rather than inability.

Among educationalists and psychologists who have conducted empirical research, there is a long tradition of writing a daily journal. In such diaries—which may be written over long periods of life—developmental processes can be recorded in natural settings. For example, the textbook illustrations made by William Stern draw primarily on his journals. From 1900 to 1918 he kept a journal together with his wife Clara about the development of their three children. According to Stern's (1967) personalistic view, a person's personality is not a given. Rather, personality is a set task. Personality comes into being as a development. Personality comes to light as the realization of the self in a person.

It is also possible to discover and understand the internal views of research subjects through their diaries. In her book *Attempt at a Holistic Portrayal of the Inner Life of Young Persons* Charlotte Bühler (1975) studied the transition from childhood to adulthood in the lives of adolescents by analyzing 52 daily journals. She followed an interpretive-hermeneutic approach:

> Anybody who wants to describe adolescent inner life needs to know and understand young people, needs to love them and be near them, needs to be able to feel their happiness and their aches as if their own. Moreover, beyond general knowledge and empathy, it is necessary to have detailed and factual knowledge about adolescent development. General observations or experiments alone cannot convey this kind of comprehensive overall picture of a whole period of development. (Bühler, 1975, p. 43).

Bühler described the daily journal as a book of development: "In addition to the directly described details it shows facts of development and a developmental direction" (Bühler, 1975, p. 51). Transitions from one developmental stage to the next can be identified and traced in detail in the journals. Many journal passages reflect adolescents' feelings of inhabiting an in-between world.

> His dealings with adults and his preparation and orientation towards life as an adult and, on the other hand, his still vivid interest in childlike play with his friends of the same age make K.V distinctly feels his being oddly betwixt and between. (Bühler, 1975, p. 191).

Summary and Outlook

Research processes are dependent on a variety of fundamental assumptions and presuppositions: assumptions about the object of the investigation, theoretical concepts and positions, decisions about the methods that are used to generate, process, and analyze data (see methodology cycle by Valsiner, 1997). Education should be conceived as an open, non-deterministic developmental process that in essence unfolds in the interactions between an educator and a person being educated. Education is a social and cultural event in which meaning is being constructed, imparted and partially constituted as tradition. If this, our, understanding of the research object 'education' finds agreement, there are wide ranging requirements that the research methodology governing the research process has to fulfill as a consequence. Methods must have the following features:

- enable the representation of changes as they occur in time.
- record the exchange processes between the subject who is being educated and his or her material, social and cultural environment.
- enable the conceptualization of the processes by which research subjects as well as researchers construct meaning.

Traditional education research was only able partially to realize these requirements. Many research projects are still based on designs that presuppose simple relations of cause and effect and that treat data as if they were physical facts rather than as the social facts that they are, i.e., as socially constructed and socially meaningful. In many cases data on individuals or different points in time may be aggregated and subsequently processed by statistical methods based on mean values. As a result of such methodological approaches and methods, the research subject appears timeless, void of individuality and socially decontextualised—a subject, in other words, that stands in stark contradiction to our fundamental assumptions about what education is and how it happens.

We discussed various already practiced methodological approaches that avoid this kind of reductionism. They can be roughly divided into two families of methods, *analytical-quantitative* and *reconstructive-hermeneutic*:

A special analytical focus of analytic-quantitative approaches is the process characteristic of educational phenomena. Theories of dynamic systems and the related methods of synergetics enable, by using mathematical models, not only the description of processes that are happening in time but also the investigation of regularities and patterns in these processes and their representation in models. If one conceives of education as a co-evolutionary process between psychic and social systems (see Thommen & Wettstein, 2009, accepted) the challenge is to reveal and analyze the relationship between patterned processes that go on in parallel, i.e.,

that are simultaneous and inter-connected. So far the solutions for this problem are mainly approaches using graphic representations. Any mathematical techniques would still need to be developed, and close collaboration between mathematicians and social scientists would be imperative for achieving this aim.

A special analytical focus of reconstructive-hermeneutic approaches is the always already socially constructed reality of all education processes. The research material analyzed by these methods are, in the main, actors' own meaningful narratives. In addition to, and from these, researchers produce their own, new narratives in a methodically controlled way. Given the linguistic form of this research material—oral or written narratives—researchers are forced in their analyses to take account of the social contexts in which their research subjects are situated and in which the narratives were produced. What is more, narratives also lend themselves to the expression of temporal relations by inevitably articulating references to the past, present, and future.

So far, these two strands of methods have been developed if not in isolation from each other then without much intersection. Given their different roots in the history and theory of science, this is not surprising. We have shown, however, how critical it would be to interlink and combine them. The qualities of both sets of methods could be put to use in a complementary way, with the aim to do methodological justice to the dynamic object of education research.

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