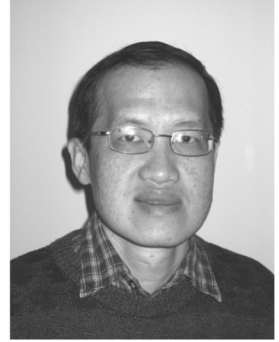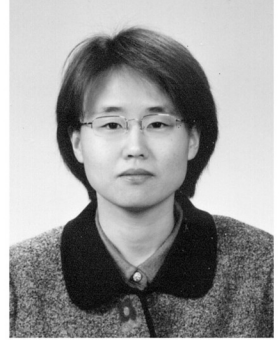# Wolff-Michael Roth, SungWon Hwang
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Participation, Learning, and Identity

Dialectical Perspectives

Volume 14

ICHS

International Cultural-historical Human Sciences

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Participation, Learning, and Identity

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is a series committed to the tradition of the cultural historical theory, which was developed by Lev S. Vygotsky, Alexei N. Leontiev and Alexandr R. Luria in order to analyze man and his development within the context of culture and social historical determination. They consider activity as the fundamental form of man-world-interaction and as a basic precondition of the theoretical, methodological and empirical study of problems of scientific disciplines and social practice. This series is meant to publish classic texts of the founders of this approach as well as new studies concerning current scientific or practical problems.

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Preface

This book is the product of writing and thinking in a dialectical manner about learning across the lifespan in and of mathematics and science—taking our cues from "The dialectic of arithmetic in grocery shopping" (Lave, Murtaugh, & de la Rocha, 1984). Over a two-year time period, our research group Chat@UVic had increased to eleven individuals involved in intense discussions about the advantages and disadvantages of taking a dialectical materialist (embodied) approach. In particular, the critical commentaries of those in our group not embracing or convinced about such frames of thought provided the authors with incentives to better clarify what we were in the process of working out. Michael Hoffmann, an accomplished philosopher and postdoctoral fellow in the group, was without doubt the most ardent of our opponents. We truly owe him a debt of gratitude in helping us reflect more clearly on the issues. But the comments, critique, and questions of the others were equally necessary in our attempts to refine a dialectical theory—these others included Diego Ardenghi, Leanna Boyer, Damien Givry, JaeYoung Han, Lilian Pozzer-Ardenghi, and Giuliano dos Reis.

The complementary research interests of the authors allowed us to simultaneously investigate disparate field sites such as kindergartens, elementary and middle school science classrooms, and scientific laboratories and hatcheries. The diverse population of people in these different sites encouraged us to rethink three core issues—participation, learning, and identity—in terms of their relevance not only in their local contexts where they emerged but also extending to other situations featuring people and groups across the lifespan.

Feedback from conference presentations gave us rich opportunities to develop our ideas that now comprise various portions of this book. For instance, Chapter 2 contains materials presented at CONNECTIONS'04, further elaborated in an article that appeared in *Journal of Curriculum Studies* (Goulart & Roth, 2005). Chapters 4–6 began with ideas initially discussed at the CON-

NECTIONS'03 and CONNECTIONS'04 conferences, and the 2003 and 2004 annual meetings of the National Association for Research in Science Teaching and the American Educational Research Association (Hwang & Roth; Hwang, Roth, & Pozzer-Ardenghi); an article appearing in *Outlines* served as the basis for Chapter 6. Parts of Chapters 1 and 7 are based on two plenary talks (Roth). The first talk addressed a policy meeting involving 25 nations of the European Union (Copenhagen, Denmark, 2002); the second talk was given at the bi-annual meeting of the European Association for Research on Learning and Instruction (Padua, Italy, 2003). Chapter 8 has its origin in a substantial reworking of a paper shared at the 2004 annual meeting of the American Educational Research Association and subsequently published by the *Journal of Workplace Learning* (Lee & Roth, 2005). *FQS: Forum Qualitative Sozialforschung / Forum Qualitative Social Research* (Lee & Roth, 2004) accepted an earlier version of Chapter 9. Again, Chapter 10 first emerged at the same conference as Chapter 8 but targeted for a session chaired by the cultural-historical special interest group (Lee & Roth).

McGinn, and Carolyn Woszczyna videotaped lessons, interviewed students, and transcribed videotapes for Chapters 4–6. Sylvie Boutonné, G. Michael Bowen, and Stuart Lee supported the curriculum and data collection on which Chapter 7 is based. Leanna Boyer and Stuart Lee were members of the team that conducted research in the hatchery that led to Chapters 8 and 10. Arnaldo Vaz assisted Maria Inês Mafra Goulart in the establishing the database on which Chapters 2 and 3 are based. We extend our thanks to all those individuals participating in the various research projects: the kindergarten children and teachers in Belo Horizonte, Brazil; the sixth- and seventh-grade students and their teacher in Vancouver who accepted Wolff-Michael Roth into their classroom to teach a four-month unit on simple machines; the seventh-grade students and their teachers in the Victoria area accepting Wolff-Michael Roth to lead them in their studies of local creeks and watersheds; the hatchery management and fish culturists who not only did not mind our stay but also welcomed us as contributors to their daily routines; and the scientist who was willing to be interviewed for a study on the construction of identity.

We all are grateful to our families, whose continued support allowed us to delve into the extended academic pursuits that resulted in this book. SungWon Hwang thanks her husband Jae Bum Lee for his ceaseless encouragement. Yew Jin is grateful to his family for its support. Marines Inês thanks her husband Eduardo Sarquis Soares and her sons Cássio and Ivan for their support in Victoria and Brazil. Finally, Wolff-Michael Roth is indebted to his wife Sylvie Boutonné.

Part I

Introduction

1 Toward a dialectical perspective of participation, learning, and identity

Toward a dialectical way of theorizing and writing research

During the twentieth century, many societies have become increasingly individualistic. Psychological self-help books are filled with advice on how to realize one's personal goals, needs, and fulfillment without ever acknowledging that our identities, who we are with respect to ourselves and to others, arise from a deep and fundamental relation between self and other. There is a decreasing appreciation of the connection between individual and collective that makes it possible that an individual can engage in, for example, the esoteric pursuit of studying Bose-Einstein condensation in dilute gases (Nobel Award 2001 in physics) without having to worry about the daily meals being on the table although he or she is not hunting, gathering, or farming. Physicists do not have to worry about where to live or where to engage in studying Bose-Einstein condensation because others, including architects, masons, and crane operators construct the office building and laboratory where they engage in their pursuit. They do not have to worry about the work of maintaining the instrumentation, buildings, and offices—the craftspeople in the machine shop, cleaners, and secretaries do that. Because of a division of labor, all these frequently unacknowledged people participate in and reproduce society; but their labor is largely hidden when it comes to attributing awards such as a Nobel Prize. In a sense, doing physics presupposes all these other activities, without which physics, as we know it, could not exist.

But the labor of others allows physicists to find out (learn) and communi-

cate evidence for and characteristics of this new state of matter. It is therefore ironic that despite the complete dependence of these physicists on the society-based division of labor, they receive and embrace their rewards as individuals. Thus, the press release for the 2001 Nobel Prize in physics states, among others that

[t]he condensates [Wolfgang Ketterle] managed to produce contained more atoms and could therefore be used to investigate the phenomenon further. Using two separate [Bose-Einstein condensates] which were allowed to expand into one another, he obtained very clear interference patterns, i.e. the type of pattern that forms on the surface of water when two stones are thrown in at the same time. (http://www.nobel.se/physics/laureates/2001/press.html)

Here the individual is being celebrated without any acknowledgment of the structural relations—community and material resources—that made learning about Bose-Einstein condensates possible in the first place.

Recent work on the nature of knowledge suggests that the predominant social structures for the ownership of knowledge are communities of practice (Wenger, 1998). Although these groups are ubiquitous and have been around for a long time—in fact, ever since humans began to control their environment through agriculture and exchange goods and services (Roth, 2003b)—educators have only recently begun to import such concepts into their practice. Characteristically, these educational efforts do not lead to sustained communities of learning, in part because the analytical unit under consideration is the individual classroom disconnected from the remainder of school and society. These classrooms are assembled for administrative purposes, generally with a homogeneous age structure, and frequently more or less homogeneous class, gender, and culture structure. The situation is not helped when assessments at the classroom level as well as in national and international comparisons (e.g., TIMSS and PISA) completely focus on the individual rather than on the collective. They pay attention to what individuals achieve independent from all social and material (tools, computers) resources that normally are available to students in their classrooms, people in society, or the Nobel-winning physicists in our opening example. In brief, there are some deep contradictions between communities of practice that have historically evolved and the design and application of these community-based theories in educational contexts. From our perspective, these problems arise from a deep misunderstanding of the nature of communities and of the relation between individual and collective.

In this book we present a series of studies on participation, learning, and identity along the lifespan from a dialectical perspective that does not pigeon-

hole individuals in culture, making them dupes or dopes that are determined by the society of which they are part. Nor does this perspective reduce society to an agglomeration of individual souls that somehow, through their interaction, produce society and culture in all its complexity. Suffice to say, our understanding is neither rooted in classical psychology, which used the individual as the unit of analysis, nor derived from classical sociology, which adopted society (or class) as the unit of analysis. Rather, we take advantage of philosophical approaches in which individual and collective stand in a dialectical, that is, mutually presupposing relationship. At various points throughout the book, we will elaborate this central position of ours.

Once this claim of the irreducibility of individual and collective is accepted, we can no longer begin analyzing and theorizing human actions and activities by taking on one or the other entity as a starting point. Doing so always leads us into the familiar if worn question of whether the chicken or the egg came first. Both entities are part of an indissoluble unit because each presupposes the other. In the study of human knowing, learning, participation, or identity, it is therefore impossible to ask, for example, who the subject is in the actions that we observe independent of the object of the actions. By the same token, it is impracticable to consider the object of the actions independent of the subject. Thus, for example, in a study of graph interpretation, we cannot assume the task as the object independent of the subject: the nature of subject and object are matters of empirical study. Sentences with transitive verbs exemplify such a relation. In the statement, "the individual interprets the representation," subject, verb, and object form a unity. Our own studies of interpretation showed that what is being interpreted cannot be assumed but has to arise from analysis for each subject, an after-the-fact matter. Similarly, we cannot predetermine the nature of the subject by categorizing the subjects as "scientists" or "students." As it turns out, there are many similarities in the actions of scientists and students—notions of who is the expert, novice, researcher or participant are inherently unstable at every point (Roth & Bowen, 2003).

One increasingly popular framework for researching such social psychological phenomena is cultural-historical activity theory (Engeström, 1987), emblematically represented in a triangle of mediations (Figure 1.1). Although cultural-historical activity theory takes activity as the molar unit of analysis, most of the over 200 articles that a search in the ISI Citation Index brought up using the search term "activity theory" actually reify the independent character of different structural elements in the activity studied. For example, we have observed that there are studies of graph interpretation, which presuppose that all research participants actually do the same task, that is, attend to the same object
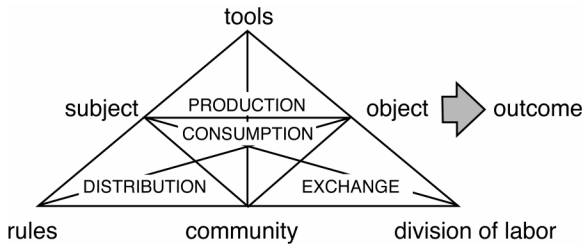
Figure 1.1. This structure of human activities according to activity theory was derived from major Marxian concepts, but changed the nature of the collective entity from society to community.

and revealing individual differences. However, it has been suggested that such studies actually might be better understood as sampling the object (the task, test) as revealing its (situated) nature (Corno et al., 2002).

The downside of heuristic representations such as Figure 1.1 is that they tend to reify the entities that they have set in relation. They appear to suggest an *inter*action of different entities whereby each can be meaningfully understood in isolation. To underscore the mutually constitutive relation of pairs of entities, the notion of *trans*action is more appropriate (Snow, 1992). In our work, we have found it useful to explicitly indicate the transactional nature of certain structures in the way of writing a dialectical concept. Thus, to make the dialecti-cal relation in some action explicit, we employ expressions such as agency|structure, subject|object, darkness|light, individual|collective, and mar-gin|center (e.g., Roth & Lee, 2004; Roth, Tobin, Carambo, & Dalland, 2004). This notation will be unfamiliar to most readers and therefore deserves some ex-plication.

In this form of writing, two mutually excluding yet mutually presupposing concepts or ideas are written as one expression internally divided by the Sheffer stroke "|." The expression thereby denotes one idea that contains a contradiction. The Sheffer stroke is a notational symbol from logic standing for "not and" or, in computer electronic parlance, for a "NAND" operation such as in "p NAND q." In our situation, we combine opposites describing, for example, a situation simultaneously as margin and center. That is, from classical logic, an expression such as "margin AND NOT-margin," where NOT-margin is the same as center, is always and inherently false according to the law of non-contradiction. But for the same reason, the operation NAND produces the inversion of the expression

"margin AND NOT-margin"—"NOT (margin AND NOT-margin)" or "margin NAND NOT-margin"—and therefore is always and inherently true. Rather than repeating any of these unwieldy expressions, we use the Sheffer stroke and construct internally contradictory but true expressions—margin|center (margin NAND center). In classical logic, this would be a contradictory statement; in dialectical logic, it is the very foundation of all forms of consciousness (Hegel, 1977). Importantly in dialectic logic, negation or affirmation is not a matter of calculating abstracted states in terms of true or false, but of praxis conducted by human beings who come to be conscious in their activities of the world they inhabit. In this approach, contradictions are central elements for they motivate movement and change.

Using the Sheffer stroke, even if initially curious and unfamiliar to our readers, allows us to keep dialectical tensions alive and to eschew the use of independent polar opposites. For example, at heart, the notion of *legitimate peripheral participation* (Lave & Wenger, 1991) is dialectic. Yet many scholars continue writing about legitimate or illegitimate forms of participation, or participation that is initially peripheral and subsequently core or central. In Chapter 2, we reconceive participation differently in terms of the margin|center concept: any participation simultaneously is both marginal and central. From a systemic perspective, an individual might be viewed as an element that possesses specific abilities or properties in her corporeal body and therefore takes a certain position such as margin or center in a given structure. But to the same individual, systemic entities such as tools, rules, and division of labor appear as a set of salient possibilities available to her action. The systemic elements and their marginal or central configurations unfold through her actions, her acting body. Thus, the acting subject herself appears as a relational form, not an element, which we represent as individual|collective.

The implications of such perspectives are perhaps least understood in much of Western scholarship, for thinking dialectically means suspending that which is intuitive and ingrained. Thinking dialectically means that we stop pursuing the question whether the chicken or egg came first and begin understanding them as mutually presupposing. We can then, on the one hand, engage in historical studies that show how the precursor of some phenomenon developed until, in a rapidly changing context, already existing possibilities became dominant and led to chicken *and* egg. In like manner, it allowed critical psychologists of the Berlin school to critique and reformulate traditional psychological concepts that Western scholars have nigh completely reified such as cognition, learning, emotion, and motivation (e.g., Holzkamp, 1983, 1993; Osterkamp-Holzkamp, 1975, 1976). On the other hand, we can perform original studies that are guided by

dialectical materialism as a point of departure. This forbids us assuming that "a scientist" will be an expert on some graph-related task, for the nature of the task (object) and participation (subject) is an empirical matter, that is, as the outcome of our study of interpretation. Our praxis of doing research this way opens up many surprises, engenders more head-scratching, and, new insights.

We earlier pointed out that we cannot value such things as Bose-Einstein condensates independent of the activities that led to the construction of laboratories, production of food for physicists and builders, the work of technicians in the running of a lab, and so forth. In fact, the objects of these different activities, the tools they employ, or the division of labor that gives rise to them cannot be understood independently of society and culture, that is, the relationship between individual and collective. A dialectical perspective of participation, learning, and identity therefore begins with considering the relation of individual and collective. This lies at the heart of understanding any human actions and the characteristically collective and cultural nature of activity.

Individual|collective: a double historical perspective

The notions "community of practice" and "community of learners" have been used as tools to analyze learning and development at the individual and, to a lesser extent, at the collective level (Lave & Wenger, 1991). It is generally less understood that the foundations of the community concept lie in the dialectical relation of individual and collective (Jean Lave, personal communication, August 23, 2000). Rather, there is an original unity, which unfolds into (from which they emerge simultaneously) individual and collective, self and other, which are non-identical aspects of an identity that mutually presuppose one another. There is no self without a generalized other (collective, society), but any consciousness of another implies a self. To understand this identity of the non-identical individual|collective unit, that is, in other words, the cultural *nature* of individual human beings, we need to first take a dual historical perspective.

On the one hand, we need to consider how it came that in the process of anthropogenesis, societies emerged characterized by division of labor and social relations so that, for example, in exchange for contributions to the survival of the society, individuals were able pursue activities other than hunting or gathering food. This allows us to understand human psychological characteristics, such as motivation, dispositions, emotions, and responsibility as grounded both in the individual and collective, the personal and social, and always inherent in the relation of subjects vis-à-vis the objects of their activities (those that they truly pursue). On the other hand, we need to consider how during its development

(ontogenesis), the individual human being is formed by and incorporates currently existing social structures (Bourdieu, 1997). In contrast to the use of concepts such as socialization, according to which children become fully-fledged members of society as a result of being shaped by external forces, we are particularly interested in a non-deterministic and non-determinate view of enculturation. There would be little cultural development if the social and material environment were the sole factors that shaped and socialized individual human beings. In a dialectical perspective, the processes of cultural reproduction and change are two aspects of the same coin. We therefore speak and write of the production|reproduction of culture.

Activities, actions, operations: foundation of sense, reference, and meaning

In this book, we theorize individual and social cognitive processes simultaneously—there are no psychological processes independently from social processes, and no social processes independently from psychological processes (Leont'ev, 1978). We understand them as mutually presupposing processes that cannot be collapsed into one another. This unfamiliar integration is achieved by beginning theory construction or data analysis with productive human behavior heuristically occurring at three levels: activity, action, and operation (Figure 1.2). Activities such as farming, raising cattle, engaging in environmentalism, or operating and urban garden arise from the division of labor at the society level; taken as a whole, the activities assure the viability of the collective much like the different forms of actions on an autarkic farm would contribute to the survival of the collective operating it (but without the markets and exchanges that characterize complex societies). Activities are associated with a conscious, collective (social) motive and thus are the most encompassing terms in this hierarchy. Actions, such as fertilizing or measuring soil acidity are associated with conscious individual (group) goals; an activity is concretely realized by series of actions. Embodied operations, such as an expert's shifting a gear while driving a tractor or the reading the output of a pH meter are associated with the conditions, which are perceived in particular but unconscious ways. Although produced by individual human bodies, operations (e.g., perception, words) are deeply cultural and correspond to the unconscious collective consciousness that have emerged from the embodiment of experiences in an inherently sociomaterial world.

These three levels of human agency are not independent, but connected in the form of two relations. These relations arise from the dialectic of an action; that is, when analyzed, every action has a double orientation. First, every action is synthesized from sequentially assembled operations, which themselves do not

type of process	orientation	plane	between-level relation		
activity	motive	collective, conscious			
				sense	
action	goal	individual, conscious			meaning
				reference	
operation	condition	individual, unconscious, embodied			

Figure 1.2. There are three levels of productive human behavior, each of which has a different orientation and occurs at a different plane. Sense, reference, and meaning are the relations that link the different levels.

have conscious goals. That is, the relation between action and operation is one of reference, the former orienting the production and sequencing of embodied operations. Second, the relation of sense links each individual action and the collective activity that encompasses it. Once an action is produced both the individual who produced the action (e.g., an uttered directive, a material action) and those others in the collectivity who perceived it attribute sense, interpret it in terms of its intentions, or account for it. That is, each action involves the dialectic of self and other, arising from a self, which itself is the product of a double historicity (see below) and providing a resource to the collectivity, self and other. Finally, meaning is the relation between sense and reference; that is, meaning is both grounded in the bodily synthesis of operations into actions, and in the social significance of the action with respect to the encompassing activity. Perhaps the most important point to be retained is that sense and reference, and therefore meaning, are associated with actions rather than things and states; that is, for example, words or representations have neither sense nor meaning. Sense, reference, and meaning emerge together in the process of acting intentionally as part of the participation in a distinct form of activity.

As an illustration of the different levels of agency and the relations between them, consider the following conversational turn between Anne and Dan. The point here is to find out what is being done (is going on) in the situation.

01   Anne: Do you want me to read it out loud?
02   Dan: Sure. If you'd like to.

We begin this analysis by considering the two turns and their relation. Anne
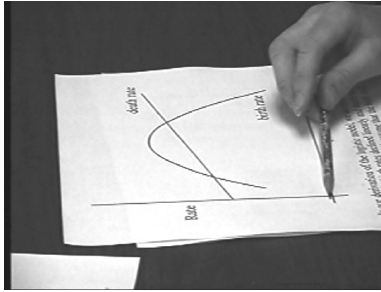
Figure 1.3. The sense of the utterances that Anne, a professor of physics, produces de-pends on the activity in which she currently participates. Any particular utterance and her participation in a research project on graphing mutually presuppose one another.

appears to ask a question (structure of the utterance beginning with "Do") to which Dan responds affirmatively. In such a reading, the first action can be glossed as "asking a question" and the second action as "responding to a question." Most adults readily produce such utterances without having to reflect or search for the particular words that form them. The words seem to emerge on their own, "at the tip of the tongue," but as a way of realizing the intended question; more so, Anne does not have to ponder how to operate her vocal apparatus to produce the sounds that we hear as "Do," "you," and so on. The generation of each word, therefore, is an (unconscious) operation *conditioned by* the action it is to realize and *conditioned by* the current state of this action, that is, the state of the utterance at any one moment. We can say that the intended action is the ref-erent for (i.e., condition) the production of the unconscious operation.

But what is the sense of the question? What is its intended effect? Here, it does not help us to know that Anne is a professor of physics close to retirement and Dan is an undergraduate student majoring in physics. Why would a profes-sor ask an undergraduate student from her department the question whether she should read aloud? Here, it may help but not explain to know that Anne has in front of her a large sheet of paper on which a graph and caption are printed (Fig-ure 1.3). The sense of *this* question emerges when we know that Anne had been invited to participate as an expert in a research project on graphs and graphing. Organized according to a think-aloud protocol, the session is being recorded. Anne in fact asks whether she also needs to talk aloud when reading the instruc-tions and caption. That is, Anne's utterance presupposes the research activity and its think-aloud protocol; and the research activity presupposes concrete ac-

tions (here utterances over and about the graph), including clarifying questions, for its realization. Sense is the condition *and* product of this relation. Together, the sense and reference relations constitute a new dialectic relation—meaning—a living and lived process. Meaning therefore is dialectically constituted in a relation that makes every action both embodied and social (cultural-historical).

Emergence of the individual|collective dialectic

In the course of human evolution, the relationship between individual and collective changed. Among animals, for example, the individual is a means for the adaptation of the species, that is, the relationship between species and its environmental niche; individual life processes have to be appropriate to the setting. Developmental patterns arise from genetic variation that makes the individual fit with respect to the environment. In humans, society and culture now mediate the relationship between individual and environment; sociocultural (societal) processes have to be appropriate for the setting. Developmental patterns are such that the individual concretely realizes and modifies the historically current sociocultural processes leading to control of the collective over its environment.

The two developmental processes are very different. At some point in human evolution, therefore, developmental patterns changed from being environmentally determined to being societal, cultural-historically mediated—the increasing use and production of tools and the development of learned social relations, divisions of labor, in which single individuals assumed partial functions in the total production of conditions. However, it does not matter which partial function the individual takes on as long as collectively all the functions are realized—which leads to some freedom of choice. These two processes allowed two qualitative leaps toward becoming human—the production of tools for generalized rather than particular purposes and the eventual shift from adaptation of the pre-humans *to* the environment to the collectively achieved manipulation of the environment *for* humankind. By contributing to this collective control over living conditions, individual subjects are able to control their own living conditions, a process necessary because humans generally no longer are able to survive barehanded in a natural environment. Collective, societal control thereby annuls the conditions under which natural selection operates on the species and instead leads to the control of conditions through societal, cultural-historical processes.

Being a constitutive part of society fundamentally changes the way in which individual humans relate to their environment. By contributing to the maintenance of society so that general and generalized needs are met and by exchanging their contribution for commodities that meet basic needs (clothing, housing,

food), human beings can satisfy their own, individual, and concrete needs. This relieves them of having to deal directly with the environment to satisfy their individual, particular needs. The physicists Wolfgang Ketterle and Anne in our previous examples can meet their basic needs *because* what they do—teaching, research, and service to the community at large—contributes to the maintenance of society as a whole. It is even possible to be part of society without contributing to its maintenance, as long as there are collectively sufficient actions at the collective level actually sustaining the collective. But it is evident that as a clochard, my action possibilities are lessened, as I am depending on the generosity of individuals and handouts for my next meal, drink, or covered place to sleep.

Being able to control one's life conditions therefore always requires moving beyond individuality and toward participation in collective control over societal processes. Thus, there is a double relation: humans *produce* and *reproduce* the conditions in which they live, on the one hand, and *are subject to* these conditions, on the other. Because historically there was a phase during which both natural selection and societal development were active, human nature became social—the expression of the *social nature* of humans is truly legitimate.

The individual becomes an *individual subject* by relating to and in union with society, the *social subject*—such relating-to always requires communication and the implied reciprocal social relations. That is, *individual subjectivity* emerges simultaneously with *intersubjectivity*—a human being becomes an individual when she experiences herself as an other to another human being, who experiences herself in the analogous situation with reversed roles (Ricœur, 1990). Thus, when Anne utters "Do you want me to read it aloud?," she already and implicitly presupposes that Dan understands; she produces sounds presupposing that they have a particular consequence, that they are *heard* as words and that is the utterance as a whole is heard *as* a question. Dan responds, and in responding shows that he understands Anne to ask a question; in responding, he contributes to the previous utterance's role as a question. He shows that the utterance was a question, not a description of something to be looked at and not as an explanation of a process. That is, even before the transaction, Anne and Dan presupposed intersubjectivity to exist—or rather, they acted as if it was going without saying or thinking about it. We arrive at the fact that human subjectivity is never just individual subjectivity but always and already intersubjectivity—our specifically human nature is based on the individual|collective dialectic. The psychological is never something isolated in an individual but constituted in and through participation in social processes. Although direct cooperation in the collective process was required initially, further historical development gave rise to the current situation that society sustains individuals even if they longer contrib-

uted to its maintenance. The collectively necessary actions are now action possibilities for the individual that may or may not be ultimately realized. As long as the collectively necessary actions are minimally completed, society survives and thereby sustains everybody. Moreover, individual actions are concrete realizations (including those that do not contribute to the maintenance of society) of more general action possibilities at the sociocultural and cultural-historical level.

Such a conceptualization, which dialectically relates individual and collective, immediately allows us to make some predictions about such phenomena as the killing sprees committed by adolescents in their schools—as witnessed recently in the USA, France, and Germany. Locking them up or even subjecting them to the death penalty will not bring about any significant change because it only removes the individual but not the generalized possibility, always mediated by society and therefore existing at the collective level. (The U.S. experience, whereby murder rates are still higher than in other countries despite the enforcement of the elsewhere abolished death penalty and despite the highest incarceration rates, only supports such a theoretical frame.)

This theoretical linkage between individual and collective leads to environmentally determined evolutionary and societal cultural-historically grounded psychological categories, including emotionality and motivation (Holzkamp, 1983). We now use motivation as an extended example to show how it is tied up with and the result of the individual-collective relationship and also always inherently embedded in the subject-object relation.

Development of individual and society

In the foregoing section, we showed how individual and society, subjectivity and intersubjectivity, emerged together in a historical process whereby natural selection was replaced by sociocultural and cultural-historical processes. Sociocultural processes are not only reproduced but also new processes are generated; this leads to the development of societies and their culture in historical time. However, sociocultural processes stand in a dialectical relation to individual processes; the former exist insofar as individuals concretely realize old and create new processes. That is, individual and sociocultural developments emerge together in mutually constitutive (dialectical) fashion. For education, this has consequences:

Only by changing circumstances purposively can man himself be changed, [and] the fostering of individuality lies in serious and vivid (i.e. creative] activity together with the pupil, activity in which the pupil is not "the object of the pedagogical process" but an equal subject of it. (Mikhailov, 1980)

Human beings today are born into a world not only structured in a material sense but also in the way other human beings transact with one another and with the child in already patterned ways. Thus, for example, today's parents produce actions towards their infants that have a relation of sense to the present sociocultural climate. In each act, parents concretely realize ways of acting that make sense today—they simultaneously act according to their culture and produce this very culture in the act. The infants participate in these actions, creating with their own actions resources and conditions that their parents can use and address in turn. That is, with each infant, sociocultural patterns of actions are both reproduced and, because no two actions are ever exactly alike, new patterns of actions are produced.

Human actions are mediated by objects and tools and always located in and with respect to a physical-material space. Object, tools, and space are therefore inherently marked, inherently used in particular ways. It is often when we travel that we experience others doing things and using objects and space in different ways; we experience that we can do differently than we have always done without ever having reflected upon our ways of doing. In Chapter 7, when the students in the environmental curriculum experienced the dissolved-oxygen meter for the first time, it was with an environmentalist (Figure 7.4.a). He used it in particular ways, which are both his (here concretely realized) and not his (designed and built by others, providing generalized action possibilities at the collective level). Each new student using the meter concretely realizes sociocultural possibilities of this time, reproduces this practice, and, in his or her own way, germinates change by opening up new action possibilities in the future. (There was a time when the meter and associated practices did not exist, and there may be other meters in the future that make this device obsolete.)

Through actions, made possible because we have bodies, human beings participate in sociocultural events; the body is the hinge between knowledgeability and sociocultural, material practices. That is, because the human body is open and therefore exposed to the social and material world it is also susceptible to be fashioned by the sociocultural and material conditions at the current historical moment. The individual is therefore thrown into socialization, a process that underlies the formation of our sense of self, other, and community. But with each individual, human society is itself reproduced, though never exactly in the same way. This accounts for the dialectical relation between individual development and cultural-historical development. If you will, in each act the individual concretely realizes cultural possibilities, comes to embody these possibilities in a concrete way, and in turn develops the cultural possibilities.

At the heart of this conception of patterned human actions (practices) lies the dialectic relation of disposition and field. Children's dispositions to perceive and act in certain ways are shaped by the sociocultural field into which they are born. But the perceptions of different aspects of historically constituted sociocultural fields presuppose the dispositions: the social and material structures surrounding children lead to dispositional structures in the form of anticipations and expectations. Although genetically biased at the beginning (nature), children's dispositions develop in the dialectical relation of existing dispositions and the fields (conditions) in which they find themselves (nurture). This leads to a practical comprehension of the world that does not require an understanding of formal structures. This practical comprehension exists in the unconscious, embodied operations that are mobilized, sequenced to conform to the relevant action referent (Figure 1.2). That is, participation in the sociocultural contexts leads to the development of dispositions, which both allow us to reify the fields and develop field-relevant practical mastery. And again, we arrive at the dialectic of individual and society, this time operational at the level of the individual. There is a dialectical individual|collective relation with respect to dispositions. Individual dispositions are never just one's own but always also those of the other; dispositions are never just private but always already social.

It is important here to note two issues. First, dispositions are not directly accessible; we can always only see practical logic generated in the dialectical relation of disposition and setting. Second, dispositions are formed not only by what we consciously perceive but also and more importantly by the totality of the conditions to which we are exposed.

After the early initiation of the child into society, he or she later becomes a member of this or that community of practice. For example, a child might decide to play soccer; in the context of a club or sponsored team, and under the guidance of the coach and other club and team members—with the support of parents who drive him or her to training and games—the child becomes an increasingly soccer player. Later in life, he or she may decide to work in a fast-food restaurant as a dishwasher, short-order cook, or sales person. Again, in the context of an existing community, the individual through this participation is exposed to a particular material and social world. Finally, the individual may even decide to become a physicist or ecologist. Again, from the interactions with others and the material world, for example, during their fieldwork experience, budding scientists develop dispositions for looking at and interpreting the formal representations (e.g., graphs) characteristic of their field (Roth & Bowen, 2001). By becoming competent, the individual also incorporates the tacit assumptions that underlie the particular community of practice, whether this concerns par-

ticular ways of dealing with dirty dishes, dos and don'ts of preparing food, or patterns of how to interact with clients. It follows that learning can be thought of as in terms of changing participation in ongoing but changing collective praxis.

In all these examples, the child, adolescent, or adult participates in relevant sociocultural activities; the individual's learning and development constitutes maintenance and renewal of the sociocultural processes. It is in this spirit that environmentalism, for example, becomes an ideal context for learning, because from an early age, students can contribute to the production|reproduction of concerns and practices that are relevant and contribute to the collective. The students in the environmental learning unit (Chapter 7) do not only learn to measure dissolved-oxygen levels and turbidity, identify organisms, collect samples and determine coliform levels but also they become agents of reproduction in a double way—they reproduce these practices and teach (in the open-house event) others in the community and thereby contribute to yet another form of reproduction.

It is immediately evident that existing cultures (communities) embody memory of their own development. With each new participant, the extant action possibilities are both reproduced (collective memory) and extended (individual and collective development). In one-room classrooms, where there are many grade levels, a similar memory exists (Roth, 2003f), as old practices are reproduced and new practices produced from variations of existing ones. In Chapter 7, when Davie and other seventh-grade and high school students become facilitators for new classes of seventh-grade students doing an environmental unit, returning parents, community activists, they constituted part of memory, the historically developed knowledgeability surrounding watershed health and knowledge that exists in this community. In most schools, however, such mechanisms for memory do not exist. At the beginning of each year, teachers are assigned new classes of students, cobbled together for administrative convenience rather than on the basis of facilitating the dialectic of individual and collective development.

Finally, our social identities, that is, who we are with respect to others, are integral aspects of the individual|collective dialectic. In each act, we not only reproduce collectively possible actions, but also we exteriorize ourselves, open ourselves to the other, drawing on resources that are always already resources for the other. When students are jerked out of their mathematics or English classes to get special treatment, they also no longer participate in the collectivity that they identify with. These are their peers, the individuals that they relate to in the class, schoolyard, in the street after school, and in their hockey club. When they are jerked out of these classes, they no longer have the same opportunities

for producing|reproducing an identity; rather, a new form of identity emerges, one related to failure. The environmental unit we describe in Chapter 7, on the other hand, gives students new opportunities for participating and contributing to the collective, new opportunities to exteriorize themselves, and thereby new forms of reproducing themselves as members of a true community.

Motivation: a social-psychological perspective

Psychologists and educators often wonder how to motivate students, for example, to do routine mathematics problems or copy science notes. Here, students evidently do not perceive a relevant motive of the activity—we recently heard about a successful student who, after saying that school was fine and that she had not trouble, noted something like, "But what has it got to do with anything?" There is no relationship of sense between socially relevant activity and the things students are required to do in schools. Motivation is therefore equivalent to making people do voluntarily what someone else wants them to do—this question is the motivational formulation of external determination (locus of control). The perennial concern, "How do I [teacher] motivate students?" or "How do I [manager] motivate employees?" therefore inherently contributes to the external locus of control rather than to the situation where motivation is inherent in the meaningful object of the activity chosen by students.

Historically, we can understand motivation to arise from a projection whereby individual needs could be satisfied by participating in the satisfaction of collective needs (Holzkamp, 1983). In the well-known example of hunting activity whereby beater actions (frightening game) and hunter actions (killing game) are coordinated, individual and collective motives coincide (Leont'ev, 1978). In this early stage of human development, that is, at the highest phylogenetic development, social relations are essential conditions for the full enhancement of biological factors; however, the individual organism is essentially constrained to securing its own existence and therefore acts in response to the current conditions (Holzkamp-Osterkamp, 1977). The specifically human form of being arises from cooperation, the synergistic interaction of competencies and abilities of different individuals, which allows the individual to expand beyond its purely biological capacities.

At an ontogenetic level, the given sociocultural and cultural-historical conditions appear to the child as the only naturally possible ones. Initially, the child depends on others and learns—in as far as it can take on certain life-sustaining functions—that it acquires a certain level of independence. Such independence can be consciously acquired through contributions to the collective endeavor. Thus, each step in the individual development simultaneously means a destabili-

zation of existing relations to the sociomaterial environment and an expansion of action possibilities through an increase in the conscious control of this environment. That is, the individual who recognizes that the contribution to the collective activity also opens up control over and improvement of individual situation is inherently motivated. Truly collective activities are always characterized by the alignment of individual and collective motivation—clearly evident in team sports. When individual and collective motivations do not overlap during joint activity, there then are contradictions, entailing coping mechanisms that either sustain or remove the contradictions. We explore in Chapter 10 some of these ideas that are of great interest to organizational theorists, among others.

We can generalize, therefore, that learning is motivated when the subject of learning anticipates that learning will lead to greater control over his or her conditions or quality of life, that is, to an increase in his or her action possibilities. It is reasonable to learn because it expands one's possibilities. Learning, motivated in this way, is inherently *expansive* (Holzkamp, 1993). (Learning for the sole purpose of avoiding a diminishing control or quality of life is *defensive*. It is associated with an external locus of control focused on avoiding or coping with menacing situations.) Expansive learning generally arises when individuals form collectives to deal with problematic situations in order to capitalize on the greater control they have as a collective (Engeström, 1987).

Expansive learning, in addition to being mediated by the collective, orients itself according to the needs of the problematic situation. Motivation is therefore tied to the object (necessarily as viewed from the individual subject) and can be understood through the concept of emotional valence (Damasio, 1999). Emotional valence reflects the current state of an individual's engagement with the sociomaterial environment in a double sense: it is a reflection of the degree to which (a) the present situation is experienced as meaningful and (b) the individual controls the situation (Holzkamp-Osterkamp, 1977). Positive emotions emerge from the successful engagement with the environment, the cognized level of control over it, and the experienced possibilities for expanding control and engagement. Negative emotions emerge when the individual feels subject to the conditions and is forced to act in the absence of conditions that would at least promise success; the individual experiences herself out of control and, with it, experiences a threat to her existence. From this perspective, then, motivation is equivalent to the emotional valence associated with the cognized goals. Motivation therefore extends beyond the current moment in that it is oriented toward increase or decrease of emotional valence arising from the expansion/securing or loss of control (action possibilities) at a future moment through the immediate actions to be taken.

This framework allows us to understand motivation, for example, in school situations. We expect low motivation among those students, who do not anticipate stabilization or increase in their action potential as a consequence of the actions to be taken; those students who can anticipate an increase in the control over their life situation will feel motivated. In anticipation of the contents of Chapter 7, the students who contributed to the knowledge base of their municipality were not made to accomplish specific tasks, like measuring stream speed and stream cross section, which they subsequently have to plot to see whether there is a relationship (correlation). They were motivated as they had a choice in selecting the object and the means of production; they contribute to the collective endeavor of environmentalism in their municipality. This had not been the case during earlier times, for the teachers asked all students to work on the same kind of investigation. Furthermore, it was one that was heavily slanted toward a traditional conception of enculturation into science and science literacy. What happened was that some of the female and aboriginal students began to disengage and the curriculum designers felt a sense of failure. It was only when the teacher-researcher (Wolff-Michael Roth) understood that in this community there are heterogeneous ways of participating that he was able to provide students with opportunities to frame how they wanted to contribute to the overall activity. We develop the issues concerning motivation further in Chapter 10, where we show how alignment and misalignments of individual and collective motives lead to individuals' identification and disidentification, respectively.

In a context where cultural practices include photographing the creek, measuring stream speed, sampling the different organisms, cleaning up and protecting the riparian areas, participation in cultural practices is coextensive with changing practices in a continuously changing world. That is, participation is coextensive with learning. Motivation to learn is inbuilt with cultural practices and the objects towards which they are directed. Similarly, the direction of learning is produced|reproduced in practice. Little wonder that as people begin to participate in ongoing practices while gaining personally desired and relevant mastery, the motivation to learn is unproblematic. The exact nature of this learning pathway depends on the particular needs of the individual and happens just in time and as needed. The exact moment of time when learning is needed depends on the trajectory that the particular individual takes, itself a function of the current state, for every future moment of the journey depends on where the individual is at the moment. This, in turn, depends on the prior history of the trajectory; that is, during learning, the individual integrates over its own history leading to an inherently contingent trajectory and biography.

Contributions to a dialectic take on participation, learning, and identity

Whereas this introductory chapter provides a general framework for conducting dialectical studies on participation, learning, and identity, each of the nine subsequent chapters organized around the three themes exemplifies how a particular aspect can be treated in a dialectical manner. In fact, the individual|collective dialectic eventually brings each chapter to a unique dialectical aspect within which participation, learning, and identity unfold one another.

In Part II (*Dialectic of learning*), we theorize two aspects of a dialectic approach to participation. Both chapters are situated in the context of science for small children in Brazilian kindergarten schools. Brazilian policies, as those of many countries, have espoused the goal of making science education available to all students. However, for a variety of reasons many students are actually prevented from succeeding in science and, consequently, from pursuing science-related careers. Past research shows that access is often mediated by gender, socioeconomic status, or culture. Less frequently investigated is age-related discrimination of participation in science education—few research studies have examined the participation of very young children in science-related activities. In *Margin|center* (Chapter 2), we employ a cultural-historical lens that goes beyond the classical theories and allows us to see learning as participation of very young children through a dialectical point of view. We suggest that the contradictions inherent in the concept of participation can be examined through the margin|center dialectic. We analyze the events in a classroom of four-year old children in a public Brazilian kindergarten school focusing on the interactions that occur during a hands-on activity about an aspect of the physical world. The case study shows us that (a) young children, too, are ready to participate in scientific literacy, (b) learning is a process of changes in concrete social practice, and (c) viewed through the margin|center dialectic, participation and learning are constituted dialectically.

Although much science education research is devoted to improve the teaching and learning of students, young children are generally excluded from this endeavor because of an apparent belief that they are not yet ready to understand scientific concepts or even follow instructions to enact experiments. In *Darkness|light: the dialectic of bringing forth worlds* (Chapter 3), we follow the same group of four-year old children, enrolled in a public kindergarten school in Belo Horizonte (Brazil), while participating in a science-related hands-on activity. We now develop the metaphors of "groping in the dark" and "stepping into the light" grounded in the darkness|light dialectic for understanding learning whereby children bring forth new worlds. In the process, they transcend the contradictions inherent in being asked to arrive at specific outcomes of their