WHAT IS LEARNING ANYWAY? A TOPOGRAPHICAL PERSPECTIVE CONSIDERED

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In the book, *California Rivers and Streams*, Jeffrey Mount (1995) describes the nature of rivers, chronicles the processes contributing to their birth and development, and analyzes the dynamic and reciprocal relation between the ever-moving and transforming river and its surrounding environs. In some cases, extrusions of igneous rock or uplift in the land force the river to go in a particular direction or limit its movement. In other cases, the river overflows its banks carrying sediment and debris, scouring the landscape and creating canyons and meander pools. As the description of the science of rivers unfolded on the pages of Mount’s book, its relevance to our own efforts to understand the nature and processes of learning became readily apparent. Indeed, the interplay between the river and the landscape in river systems seems to echo many aspects of the ever-changing interactions among what is to be learned, learning situations, learners, and the always present countenance of time. Thus, in this paper, we in effect take on the mapping of learning, much like one seeking to chart the features and movements of a river as it changes over time.

We accept that to accomplish our task, we must first deal with some fundamental issues that would also be confronted by those mapping river systems. One of those issues is offering a viable definition of learning that emerges from a systemic consideration of the construct. On this point, our endeavor parallels the conceptual challenges faced by river scientists. For instance, what makes a river a river or, more precisely, how does one distinguish between any flow of water and flows that merit the label *river*? Another issue we faced was ascertaining the essential dimensions underlying learning. Similarly, rivers must be understood as parts of entire systems with critical elements that are in continual flux. Thus, a river scientist must contemplate how the nature of the surrounding land (bedrock, soil composition, or vegetation) and the force and magnitude of the water flow interact to give the system its character; how those living near the
river are changed by its existence and at the same time change the river by their very presence. Further, river scientists must be sensitive to changes that occur within the river system with the passage of time. Likewise, in our conceptual mapping, we must attend to the continual interplay of the what, where, who, and when dimensions of learning.

One of the reasons the theoretical endeavor upon which we embarked is of significance is precisely this lack of concurrence within education and psychology as to the nature of learning (Alexander, 1997; Eisner, 1997; Mayer, 2001; Reynolds, Sinatra, & Jetton, 1996; Schallert & Martin, 2003). In fact, contrasting and contentious views of learning dot the educational landscape and hinder progress in this domain for researchers and practitioners alike. Nonetheless, learning remains core to educational/psychological endeavors despite its problematic and elusive nature.

With this awareness of the strongly held, sometimes oppositional, views of learning that have been espoused within the educational and psychological literatures, we conjectured that the topographical mapping of learning would be better undertaken by researchers who not only had a long history of involvement in this domain, but who would also come to the mapping task from varied theoretical perspectives. Specifically, our goal was to integrate views of learning that have emerged from cognitive contextual (Anderson, 1977; Bransford, 1979; Piaget, 1926; Spiro, Vispoel, Schmilz, Samarapungavan, & Boerger, 1987), sociocultural (Anderson et al., 2001; Vygotsky, 1978; Wertsch & Kanner, 1992), cognitive-evolutionary (Donald, 1991; Geary, 2005; Pinker, 2002; Plotkin, 1998), and situated (Cobb, 1994; Cole & Engström, 1993; Greeno & van de Sande, 2007) perspectives by constructing a topographical mapping of learning that would adequately document its salient features, depict the dynamic and reciprocal relation between learner or learners and the world at large, and chart its developmental course. Our strategy in
crafting this topographical map of learning was first to seek the common ground from which we could move forward. We knew it would not be difficult to identify the points of contention between our theoretical orientations toward learning. Although contention and difference are often the catalyst for beneficial theoretical discussion and debate, we suspected that the explication of our individual and distinct vantage points would at a minimum obstruct our progress and at worse scuttle this enterprise.

Once we had staked out this common ground, represented here in the form of shared principles, we specified critical dimensions of learning that we conceive as the parameters of this complex landscape. With these principles and dimensions in place, we ventured to craft a definition of learning that we think is a valid reflection of this dynamic and complex construct. Finally, we considered varied cases of learning to instantiate our mapping and to illustrate how seemingly competing models or theories can be reconciled by adopting a topographical orientation.

Finding Common Ground

Given that we were focusing on a terrain as complex and dynamic as learning that has both a rich history in the scientific community of educational and psychological researchers and wide currency in everyday interactions, we began our attempts with a clear understanding that we must navigate the landscape cautiously in order to circumvent obvious barriers that have previously hindered progress in discussions of learning. Like Wilson (1998), we sought *consilience*, a term introduced by Whewell (1840) to describe unity of knowledge across varied disciplines. Here we appropriate the term to refer to our efforts to find commonality across varied perspectives in the same field. Our approach to locating this common base was to articulate guiding premises about learning upon which we as individuals and representatives of
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different theoretical frameworks could agree. The outcome of this initial theoretical compact was
nine foundational principles about the nature of human learning:

- **Principle 1**  Learning is change
- **Principle 2**  Learning is inevitable, essential, and ubiquitous
- **Principle 3**  Learning can be resisted
- **Principle 4**  Learning may be disadvantageous
- **Principle 5**  Learning can be tacit and incidental as well as conscious and intentional
- **Principle 6**  Learning is framed by our humanness
- **Principle 7**  Learning refers to both a process and a product
- **Principle 8**  Learning, as process or product, may differ at different points in time
- **Principle 9**  Learning is interactional

Note that even though we will often use the unmarked word *learning* in this discussion, and even
though some of the descriptions we offer may well apply to a broader class of living creatures,
our focus is on human learning.

*Principle 1: Learning Is Change*

A fundamental characteristic of what it means for humans to learn is that change
happens. This notion of change applies whether the focus be on simpler learning of physical
movements (e.g., skipping on one foot) or more complex learning of abstract principles (e.g.,
understanding Brownian motion). To a socioculturalist, change may occur as individuals or
groups develop social practices. To a cognitive-contextualist, change may be regarded as altered
conceptions that arise from person-environmental interactions. To a cognitive-evolutionist
change might be represented as arising from person-environment interactions as framed by the
evolved, innate processing capacities of the human brain/mind and the adaptive nature inherent
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in human beings. Like a river carving its way through a landscape, changing itself as it changes
the landscape, when learning has occurred, the learner is changed in some way and thereafter
acts in and on the world in ways that change the world.

Principle 2: Learning is Inevitable, Essential, and Ubiquitous

Being alive means being a learner. Being alive for humans brings with it the inevitability
of learning, as well as its necessity. In effect, one cannot prevent learning from occurring
(inevitable), nor can one hope to survive unless learning happens (essential). Moreover, learning
is not relegated to any singular physical, social, or cultural context, but unfolds wherever humans
move in the world (ubiquitous). Indeed, learning is a biological imperative for human beings; so
much so, that most of learning happens automatically and is not under the conscious control of
the learner (Bargh & Chartrand, 1999; Norman, 1968; Reber, 1989). In his commentary on
human memory, Flavell (1971) asserted that children do not need to be taught how to remember;
memory happens. So it is with learning. Humans are evolved learners, and through maturation
and experience certain aspects of learning become seemingly effortless and below the level of
consciousness, while other aspects become more complex, differentiated, and demand conscious
effort (Bransford, Brown, & Cocking, 1999).

Of course, learning is not unique to humans. Still, although the learning of non-human
animals has received much attention from researchers, particularly in the first half of the 20th
century, it is not difficult to gain consensus on the point that humans are fascinating examples of
learning systems (especially to other humans). What makes humans so fascinating as learning
entities is that they enter the world in such a helpless state but possess innate abilities that avail
them of the opportunity to acquire understandings and procedures over a short period of time.
Such innate abilities coupled with environmental and contextual affordances permit humans to
navigate even complex and arduous social and physical terrains. Further, human learning continues over the lifespan.

Learning is ubiquitous, applying in all sorts of situations and in all sorts of environments. Even though we are prone to nest learning in schools and associate it with formal educational systems and procedures, learning will not be so delimited. The processes of learning are in operation whenever and wherever humans are situated.

**Principle 3: Learning Can be Resisted**

As inevitable, essential, and ubiquitous as learning is, a curious corollary is that there are instances when humans resist change, even finding it painful. Resistance does not make us immune to change. In fact, there are many times when we learn in spite of ourselves. Why might that be? Why are we sometimes so reluctant to engage in the effort required to learn a new way of perceiving or acting even when the goal is desirable? It could well be that the effort required is judged as too great, or the rewards too small (Kahneman, 1973; Wigfield & Eccles, 2000), or the likelihood of success deemed too risky for learning to be pursued. Or, it is possible that the attainment of the desired goal might create dissonance within the individual or particular social system that cannot be tolerated. Thus, it often happens that opportunities for changing deeply held or habitual ways of interacting with the world are sometimes, at least initially, circumvented, resisted, or denied. Conceived in this manner, this principle of learning embraces much of the theoretical and empirical work within the literatures on conceptual change (e.g., Vosniadou, 2003) and epistemic beliefs (e.g., Murphy & Mason, 2006).

**Principle 4: Learning May be Disadvantageous**

It seems clear that learning results in changes that are not always advantageous to self or others. Yet, because the construct of learning has such positive connotations, it may be important
to make this principle explicit. We cannot limit learning only to what is valued, accepted, or acceptable. The construct of learning applies as readily to the student who has learned to disrupt a teacher’s lecture as to the student who has learned to be respectful and well-behaved; to learning a concept incorrectly as to learning it correctly; to the person who has learned to be helpless when confronted with a new or challenging task as to the person who responds strategically and efficaciously; or to learning of socially unacceptable behaviors (e.g., the ways of a gang) as much as to learning of culturally-valued attitudes and behaviors.

Here we must clarify that the notion of advantageous or disadvantageous that we forward has two valid interpretations. On the one hand, there is the learning that happens when someone has learned something that he or she wishes had never been learned. On the other hand, there is the learning that is utile and satisfying to the person (and perhaps a group of like-minded individuals), but disadvantageous and undesirable to some broader social group. Although the more positive and advantageous outcomes of learning are what may be sought, especially formally, the human system does not discriminate.

**Principle 5: Learning Can Be Tacit and Incidental as Well as Conscious and Intentional**

Much (perhaps most) learning happens outside the realm of conscious control or intentionality (Epstein, 2001). To a large extent, learning is tacit and incidental. Often learners cannot give an explicit rendering of when learning occurred, how learning happened, or how they were changed. Even in the classroom where academic development is the business at hand, much of learning lives in the water table below the surface. What proportion of learning is tacit remains debatable; Bargh and Chartrand (1999) suggested that as much as 90% of all learning is implicit. Whatever that proportion is, we would agree that, just as in the physical world, there is more below than on the surface of learning’s landscape.
For example, a student learning the concept of solving for an unknown in an algebraic equation is learning mathematical ideas, and we would say this is the student’s intentional task. However, at the same time, the student is learning the language of algebra with its peculiar vocabulary, symbolic representations, and syntactic constructions, as well as the social practices that this algebra classroom prefers, such as how solutions should look on paper or how homework pages should be stapled. Turning to out-of-school examples, we want to point to the largely unconscious and incidental nature of first language acquisition and of motoric development, where in both domains the interaction of environment and innate human wiring results in particularly suitable outcomes (Chomsky, 1957; Clark, 1994; Wells, 1987). Moreover, even when acquisition was initially effortful and conscious, subsequent use of that learning can appear tacit. Language is again a great example as when individuals automatically deploy what they know about words and the syntax of their language even as their conscious focus is on how to express what they want to say.

**Principle 6: Learning Is Framed by our Humanness**

Our humanness plays a critical role in how we learn and what we learn. Here we are primarily referring to the contribution of the particular biological architecture humans have developed. To paraphrase Mr. Spock on Star Trek, we are “carbon-based” lifeforms whose senses are our conduits for interacting with the world and with others who populate that world. Those senses are particular in structure for our species and limited in range. Our senses are restricted by their evolved structure and the environment that has surrounded them across time. Consequently, the colors we see, the tones we hear, the smells we can detect are also constrained by our evolved biology.
It is not just that our neurological and biological bases frame the processes and products of learning. Even within the range of human possibilities, there is variability with which we must contend. Just as some of us are taller or faster than others, some of us have greater visual acuity, or memory capacity, or facility with language than others. Indeed, there can be significant differences between individuals with regard to any cognitive or non-cognitive factor. In essence, these physiological differences set upper or lower boundaries within which learning may be constrained in the human system. Thus, just as our evolved human biology—that which makes us human—must be embraced in any model or theory of learning, so too must the differences that manifest at the level of the individual.

**Principle 7: Learning Refers to Both a Process and a Product**

Descriptions of learning frequently toggle between portraying learning as a process (i.e., a set of operations progressing through time) and depicting it as an end-product of that process, much like a chemical substance is produced when elements are combined. When we think of learning as a process, we are focusing on describing the time course of operations resulting in relatively durable changes. When we consider learning as product, we are referring to the relatively durable change that results when learning has occurred, as when new ideas or procedures have been internalized or memories accumulated as a result of experiences in the world. Where learning as process refers to the change as it is taking place, learning as product refers to the outcome of that process. Formal measures of learning are almost always about learning as product—the consequences of learning. Although it is perhaps unfortunate that the same word refers to a progressive action and a gerundial noun and may lead to misinterpretations that pivot exactly on this difference, it is our contention that any comprehensive model or theory of learning must regard this construct as both process and product. Indeed, research in which the
focus is only learning as a product may oversimplify our conception or obstruct our view of the learning process.

Principle 8: Learning, as Process and Product, May Differ at Different Points in Time

Because learning is a process, change transpires in time and over time, and leads one to focus on the dynamic flux of factors affecting the beginning, middle, and late stages of learning. The learning process itself is affected by where the learner is in a progression to increasing expertise and acquisition of knowledge in a domain. This developmental view of learning is tied in part to the neurological and biological changes that come with age (Bjorklund & Pellegrini, 2001). We learn differently at different ages, and the process of learning changes, reflecting the accumulation of experiences that give rise to more complex understandings and more intricate relationships among individuals or the relations between person and the environment (Bereiter, 2002; Wentzel, 1999). As mature individuals, we cannot draw aside the veil of life experiences to see the world as we did in our childhood. We may seek to “remember” what we thought or felt, but those memories are never replications or duplications. This phenomenon occurs in part because of the recursive and iterative nature of learning; processes result in products, which in turn influence subsequent processes. An often-cited example of the recursive and iterative nature of learning can be found in the Matthew effect (Stanovich, 1986). Simply stated, the Matthew effect occurs when a learning product (e.g., the decoding of words rapidly and accurately), interacts with the process of learning. Those with decoding facility read more and hence acquire more background knowledge, which in turn leads to better understanding of future information and more reading, and so on.
Principle 9: Learning is Interactional

When river scientists describe the processes that create rivers, a central tenet they advance is that rivers are created by the continual interplay of water and environmental variables. The water sculpts aspects of the landscape, while aspects of the landscape shape the river. When we say that learning is interactional, we are highlighting that learning engages an intermutual sequence of operations shaped by human culture and biology, and how humans act and react to a dynamically changing world. All serious discussions of learning would agree that the world "out there" matters to how learning takes place, although there might be debate in how to construe that world (Bereiter, 1994; Stanovich, 2000). Moreover, any post-behaviorist learning theory would include in a description of the interactive nature of learning, the iterative co-influences between current and past constructions of an individual or group. In this interactional mix, continual change occurs not only to learners, but to the context in which learning is embedded as well. Learners are influenced by, and at the same time push back, take from, change, control, and create the environment in which learning is situated.

Framing the Nature of Learning

In conceptualizing learning, we assert that it is constituted of four dimensions that are continuously interwoven and interactive, represented by the what, where, who, and when of learning. Although we will describe each dimension separately, the interactional perspective represented by Principle 9 holds that learning involves the continual interplay of multiple dimensions at any point or under any circumstance. Indeed, we describe our rendering of this emergent model of learning as topographical precisely because we think the interplay among these four dimensions results in a shape to learning that is fluid and dynamic, but that also gives rise to discernible and predictable patterns.
We have found that contrasting views of learning nearly always acknowledge these dimensions. However, a point of contention for learning theorists, as evidenced in our own discussions and debates, frequently rests on which of these dimensions holds greater sway in conceptualizing the process or products of learning. We have attempted to avoid such conceptual undertows here by offering what we regard as a more fully integrated rendering of the what, who, where, and when dimensions. We found that more attention seemed allotted to the person-environment interactions in previous theoretical models. For that reason, we have chosen to frame our discussion of learning by beginning with the what of learning and by concluding with the when of learning, dimensions of seemingly less import in past accounts. As we will seek to illustrate via particular cases, the contrasts emphasized between and among models and theories of learning may represent the differential positioning of these theories within this multidimensional space.

**Dimension 1: The What of Learning**

A comprehensive model or theory of learning must give due consideration to the objects or foci of that dynamic system (Giussani, 1995). There is always a what that is being learned or that is in the process of change. Further, there is ample evidence that the objects of learning are distinguishable and classifiable, and that those differences are significant in how the process of learning unfolds. For our purposes, we propose that the what of learning can be well represented by different levels of complexity ranging from acquired habits and conditioned responses, to spontaneous concepts and action sequences learned in everyday informal interactions with the world, to scientific concepts and practices that are often the result of formal education (see Figure 1).
We appreciate that there may be other systems of classifying what is learned that rely on other features or mechanisms than complexity; witness Spiro’s (with Feltovich, Jacobson, & Coulson, 1992) insightful identification of important differences between well-structured and ill-structured domains. We do not view these alternatives as problematic, provided that they are justified and defensible. Rather, our critical point here is that models and theories must take account of the differing objects of learning in some manner and not treat learning as a unitary outcome. For instance, it is not our goal to support or refute behaviorism as a theory of learning, but rather to argue that certain premises underlying a behavioral perspective are easier to understand if one stays within the realm of acquired habits. When behaviorism meanders away from this familiar terrain, it is far less sustainable, as the history of psychology has so clearly demonstrated. Of course, the same argument can be directed toward any other theory of learning. Our contention is that certain conflicts between models and theories of learning rest on their disregard of this very concern.

Our decision to center on complexity as the distinguishing feature of what is learned in this topography was predicated on its viability when dealing with the principles previously articulated and the dimensions now under consideration. For instance, the first rung of this complexity ladder acknowledges the neurological and biological bases of learning. Inborn reflexes, abilities, and capacities are initiating points for future physical, cognitive, and psychosocial development. Whereas such inborn reflexes, abilities, and capacities are not learned, they represent the primordial matter from which learning emerges over time and space, particularly influencing the least complex form of what is learned, acquired habits and conditionings.
Consider, for example, what might qualify as inborn reflexes, abilities, and capacities for the domain of reading—a domain with which we are intimately familiar? For one, we might regard certain perceptual and visual processes, such as the ability to discriminate light and dark areas or to discern objects in the visual field (Gibson, 1966), as among the hard-wired behaviors that support children’s later literacy development. The ability to see light and dark or shapes comes with the human system and is, clearly, not reading in itself. Still, developing literacy is reliant on these human capacities. Similarly, newborns without serious impairments can hear and make sounds (inborn abilities) from the moment they emerge from the womb. Further, within a matter of months, most infants gain the ability to hear and pronounce a range of phonemes representative of the language they hear around them, even as they hold a book, grasp the corner of a page, and dexterously turn to the next—acquired habits and conditionings that will remain foundational to the domain of reading.

At the next level of complexity are the spontaneous concepts that humans acquire from the extraordinary number of different learning situations they encounter, informally or incidentally, over the course of a lifetime, from dressing one’s self to engaging in appropriate social conversation, from cooking a meal to learning how to parent. Such spontaneous concepts, with their associated actions and emotions, can acquire the status of scientific concepts and practices, the most complex form of learning, as when one realizes a love for and interest in cooking and takes up the preparation of becoming a chef or a food science expert. The role of spontaneous concepts and actions are very evident in early literacy development, for instance, as children begin to acquire print concepts and reading conventions through social interactions with those that populate their environment.
Our choice of the term scientific concept follows usage introduced by Vygotsky (1934/1986) to represent, not concepts about science as a discipline (or not only about science), but to refer to “languaged” ideas that have become abstracted or generalized from human interactions and aligned with formal disciplines or communities of practice. Thus, scientific concepts are often associated with intentional learning or formal knowledge (Gardner, 1991), in contrast to spontaneous concepts that are, in effect, less formalized understandings often acquired from everyday experiences (Vygotsky, 1934/1986) and often associated with unintended or incidental learning (Reber, 1989; Shiffrin & Schneider, 1984). Thus, as one travels up the ladder of complexity, there may be an increased need for the support and guidance of others to assist in one’s learning (Anderson et al., 2001; Cobb, Wood, & Yackel, 1991).

In addition, as the learning becomes more complex, there is the real possibility that a successful outcome will necessitate greater effort exerted across time and place. In essence, with increased complexity comes the awareness that learning rarely is a singular or solitary event. Because reading development continues across the lifespan, there are many scientific concepts and practices that come as individuals engage in increasingly demanding and specialized print-related activities. For instance, scientific concepts and practices come into play as individuals encounter technical or domain-specific texts or are introduced to new genres or new ways of analyzing a variety of traditional and non-traditional texts.

Note that we are not making our levels of complexity coincide with a concrete to abstract continuum, or one that would place physical actions as our simplest form of learning and high-level concepts as our most complex. The increasing complexity we are representing in the what dimension of learning refers to the degree to which what is being learned involves degrees of nuances and complications in human systems that have had to be worked out as a body of
knowledge. Thus, the complex understandings that a new football player needs to acquire include concepts, attitudes, motor procedures, and perceptual patterns that represent a scientific level of knowing reflective of the accumulated wisdom of the team’s more experienced players and the coaching staff. As we will discuss later, the what of learning interacts with all other dimensions. So, for example, different football players will interpret and enact the collected wisdom of a team differently, illustrating how the who and the what interact.

**Dimension 2: The Where of Learning**

Learning does not happen in a vacuum. The where of learning refers to the ecological context in which learning occurs. By ecological context here, we are referring to how such aspects as the physical environment and the sociocultural milieu are intertwined and interdependent in their influence on learning. As shown in Figure 1, a representation of the what dimension might be conceived as layers; a representation of the where dimension, by comparison, could be represented as intertwining roots crossing the layers of complexity. An interesting characteristic of this ecology is that there is an intermingling of the more concrete with the more abstract, and of the more physical with the more social, influencing the learning process at every turn. As in a river system, there are physical elements and tangibles to the learning ecology that shape the flow of learning. As well, there are sociocultural influences that emerge from the cultural practices and social dynamics in which the learning is taking place, especially at higher levels of complexity.

Consider for example a one-year-old who has discovered the wonders of banging a spoon on a highchair tray. At this point, banging requires a coordination of movement that may have begun accidentally but quickly developed into a rhythmic movement with its attendant cacophony of sounds. The physical context impinging on learning may involve the processing of
the distance between hand and tray and of how the spoon fits in the child’s hand for maximum
effect. At this point, the sociocultural context may include how adults in the family interpret and
react to the child’s banging, the particular kind of highchair and spoon that have come to be used
in that home, and the language the child hears to label the action and sounds associated with
banging.

As the child grows older, the context surrounding drumming may develop to include
what it means culturally to learn to play the drums musically, with all its related cultural
practices. Reading musical notation, knowing when to quiet a drumhead, and responding to a
conductor’s subtle direction become contextual features to which the budding percussionist must
appropriately respond, even as our learner reacts conceptually, motivationally, and emotionally
to the degree to which this new skill is appreciated by the local culture. Certain aspiring
 drummers may benefit from supportive individuals or groups (e.g., families, peers, or mentors),
while others cannot avail themselves of such resources. Our percussionist may need to learn to
respond differently when playing in a marching band versus an orchestra versus a garage pop-
rock band, all the while using flicks of the wrist and movements across skins that are similar and
yet different to make the appropriate beat mix in with the music being produced by other
musicians. Moreover, as learning proceeds, what the learner takes the context to be changes. This
ever-changing interpretation of what exactly is salient and relevant about the contextual ecology
influences the process and products of learning.

One of many domains in which contextual influences have been studied is reading.
Context has come to mean many things within this domain. It sometimes pertains to the texts
themselves, including their organization, structure, and features (Chambliss & Calfee, 1998;
Meyer & Poon, 2001; Schallert, 1976). Context can also refer to the physical place in which the
reading occurs, such as in the home (Purcell-Gates, 2007), in the classroom (e.g., reading class or other content domains; Jetton & Alexander, 2004), or in out-of-school environments (e.g., libraries, museums, or everyday locales; Moje & O’Brien, 2001). Or, it can relate to the mode or medium of delivery, (e.g., on-line or hypermedia environments; Leu et al., 2007). The where of reading can also focus on the human resources that are present and which may serve to facilitate or inhibit the learning process or its outcomes (Allington, 2001; Almasi, 1995).

Finally, as with the other dimensions, the where of learning interacts with the what, who, and when. To explore just one of these interactions, we want to highlight how a learner’s relation with context changes over time. When one is learning something new, the particular physical environment and sociocultural setting are critical to how the learning proceeds. In fact, these details of context are so critical that often one’s initial steps in learning will incorporate them as essential components of the learning, leading to learning that seems tied to the situation. Theorists of a certain persuasion might claim that all learning is like this, situated in particular contexts of practice (Greeno & van de Sande, 2007). However, exactly because contexts are themselves always changing, the learner must continue to adjust, to adapt, to broaden the application of what was learned, to respond appropriately to contextual cues in the here-and-now that are close enough but slightly different from the context that was in place when learning “began.” Context matters.

**Dimension 3: Who Is Learning**

With the who dimension, we are pointing to how learning is influenced by characteristics of the learner along biological, cognitive, sociocultural, physical-maturational, and motivational-emotional lines. Further, we acknowledge that the particulars of all that a learner brings to a situation critically influence the process and product of learning. Indeed, over time humans have
evolved a number of innate learning capacities that have helped them become more efficient and effective learners. For example, humans appear to have a capacity to distinguish between a temporal string of non-related stimuli and a similarly appearing string that displays a series of cause and effect relations (Bjorklund & Pellegrini, 2002; Kant, 1787/1963; Reynolds & Sinatra, 2005).

In important ways, we are not invested in learner characteristics as variables that might result in higher achievement or better performance on high-stakes measures for some learners as opposed to others. Our focus is more precisely on learning and not achievement—terms that we feel have been confounded in the educational and psychological literatures (Alexander & Riconscente, 2005). Yes, people as learners differ greatly. Yet, as the particulars of the what and when of learning unfold in time and space, different facets of the who are instantiated or become more salient. In effect, certain characteristics of the learner are emphasized or de-emphasized through interaction with what is being learned, in what context, and at different points in time. Of course, we could as easily say that different particulars of the where are highlighted by virtue of the different interactions that are made possible when individuals with all their differences come into a situation.

The kinds of learner characteristics that we think are important are several. First, there are the biophysical characteristics. We acknowledge that simply by virtue of evolved biology and how humans are wired, who the learner is plays a critical role in the learning process. The embodied consciousness that represents the human learner cannot help but shape the learning process (Lakoff & Johnson, 1999). Also, there are cognitive variations for nearly every human characteristic. For example, although it is highly unlikely to find a person with more than three times the normal working memory capacity, there is variation in working memory capacity
across humans and in the ability of the brain to process information efficiently. These differences can be detected in both the processes and products of learning. Take reading as a case in point. There has been great interest in fluency within the reading research. To a degree, readers’ fluency is associated with the graphophonemic abilities they bring to the text, combined with their working memory capacity and their skill at producing the desired sounds and expressions.

Another source of influence is represented by learners’ motives, intentions, and general psychological traits. What are the learners consciously or unconsciously seeking to achieve? How do their psychological propensities foster or frustrate those intentions? Recently, much attention has been paid to motivational and affective differences among learners. As this literature reminds us, individuals not only manifest different goals for learning, but also ascribe different values to learning, have varied expectations for success (Linnenbrink & Pintrich, 2003; Pintrich & Schrauben, 1992; Wigfield & Eccles, 2000), and experience different emotions during the process (Pekrun, Goetz, Titz, & Perry, 2002; Damasio, 2005). Different psychological traits (e.g., persistence or extroversion) influence the learning of individuals even when they find themselves pretty much in the same physical context confronting the same cognitive task (Matthews, Zeidner, & Roberts, 2006).

The motives, intentions, and interests of readers have garnered increasing attention in the last decade (Guthrie & Cox, 2000). This growing presence has illustrated that those who perform well at a given reading task or who manifest a positive learning trajectory in the domain have more than the neurophysiological basics. They also have a reported interest in reading generally or in the particular domain or topic of the text (Wade, 2001). They are more likely to report an orientation toward learning about reading or the domain/topic than toward simply doing
adequately on the task (Hidi & Harackiewicz, 2000). And, they are more apt to hold beliefs about themselves as readers and about reading that will sustain them and promote their cognitive and affective engagement (Dai & Wanga, 2007).

Learner characteristics also come into play in descriptions of learning that acknowledge individuals’ previous learning, the relevant knowledge they have acquired that they bring to bear in a particular learning situation (Anderson, Reynolds, Schallert, & Goetz, 1977). We point to the extremely prolific research on how prior knowledge influences learning. The particular interface between what one knows and what one is learning intimately influences what is understood from the interaction and what one takes away from it.

A relevant example comes from a study by Walker (1987) that combines two of these ways of differentiating learners. Participants (Army enlisted personnel) were assigned to a high or low group based on their scores on a standardized ability measure (a proxy for intelligence or aptitude to learn) and to a high or low knowledge group based on their responses to factual questions about baseball. Then, everyone listened to a description of a half inning of play of a fictitious baseball game. Measures of learning came from having the young recruits retell what they had heard and also answer multiple-choice or short-answer questions about the half inning.

Results indicated that participants with high baseball knowledge did better than those with low baseball knowledge whether they came from high ability or low ability groups. In fact, within the high knowledge groups, low ability participants recalled as much of the play-by-play account as high ability learners, and the low ability/high knowledge group outperformed the high ability/low knowledge group. Where ability seemed to help the learners was in being able to figure what might be required when answering cued recall (short-answer) questions, with low
knowledge/high ability individuals scoring significantly more points than low knowledge/low ability participants.

Walker’s study is interesting in the context of our consideration of the importance of learner characteristics because it juxtaposed two different ways of thinking of how learners can differ from one another. There are many other studies, some to which we have been intimately connected, that have demonstrated the clear impact that prior knowledge can have on learning something new (Alexander & Murphy, 1998; Anderson et al., 1977; Goetz, Schallert, Reynolds, & Radin, 1983; Reynolds, Taylor, Steffensen, Shirey & Anderson, 1982). As two of us wrote nearly 20 years ago (Alexander, Schallert, & Hare, 1991), there are many forms of prior knowledge that have the potential to influence, sometimes positively sometimes negatively, what and how much a person learns from the current situation.

One of these forms, sociocultural knowledge, represents the mostly tacit, unconscious knowledge each person acquires about what has come to be called the cultural practices within particular situations. By cultural practices, we are referring to ways of acting, thinking, or feeling that a group to which a person is affiliated or wants to affiliate will consider the normal ways of acting, thinking, or feeling. Exactly because these cultural ways are often not the objects of formal education and seem to come to conscious attention only when someone, a newcomer or young person, behaves or reacts differently, they are sometimes difficult to acquire. For example, it is considered rude in Korea to hand anything to someone else with just one hand, especially if the recipient is older than the giver. As a sign of one’s own sensitivity to the other, a “giver” will use two hands to pass over something, even if it means that he or she (but especially she) is forced to put the free hand on the elbow of the other arm. A Westerner, by contrast, may notice the practice, but it could take much time and effort for this response to become automated.
Dimension 4: The When of Learning

Our consideration of the what, who, and where of learning is not unique in that others have similarly noted, in their own way, the multidimensional aspects of human learning (Jenkins, 1974). The fourth dimension in our topography, however, has received less consideration in models and theories of learning especially in conjunction with the aforementioned dimensions. Yet, just as learning does not occur in a vacuum, there is always a temporal nature to learning. As humans, our movements in the world are inevitably constrained both by time and space. With each imperceptible moment, the frame for learning has shifted, not merely because the place itself has changed (e.g., light refractions or creature movements), but because the learner himself or herself has changed, however inconspicuously, from time 1 to time 2. Thus, a learning moment can never be duplicated, only approximated. It is precisely because of the invasiveness of time throughout this topography that we conceive of it as a force that must be addressed.

We find many iterations and variations on the dimension of time within the educational literature, each representing different gradations in the span of time considered or the distributions of events or the number of relevant experiences within a given time span. Consider the time frames of evolutionary theories vis à vis sociocultural, cognitive-contextual, developmental, and situated perspectives on learning. For evolutionary theorists, the course of time that is of importance can be millennia or eras, as their concern is the mental adaptation and the consequent development of the human species as a result of mutation and natural selection. Thus, one might study aspects of learning that are biologically primary (numeracy) or secondary (reading) or the role of evolved adaptation in human development (Ellis & Bjorklund, 2005; Geary, 2005; Pinker, 2002).
For socioculturalists, time is framed by the history of a particular group, which could encompass months, years, or even centuries. Thus, one might study the cookie-selling practices of girl scouts (Rogoff, 1990), the ways in which graduate students come to adopt the proper stances, idiom, and understandings of a discipline (Fox, 1994), or the meaning and import of literacy to individuals born at different points in the 20th century (Brandt, 2001). The time perspective of developmental psychologists, by comparison, is the human lifespan and the predictable neurobiological, motor, cognitive, socioemotional changes that come with maturation and experience. The characteristics of young children as learners may be compared to those of older children, adolescents, or adults. By comparison, models and theories concerned with learning in situ appear more concentrated on the immediate temporal unfolding and on how words, actions, or cultural artifacts are plied by individuals or groups around shared problems or tasks.

Time plays another role in certain learning theories when we consider the frequency with which individuals encounter certain conditions or are embedded in particular experiences that promote learning. Here it is not time per se that matters but the flow of experiences or the availability of human and non-human resources that come with the flow of time.

The intersection of these time orientations with the what, who, and where dimensions of learning can be well illustrated in the study of expertise development within complex domains (Alexander, 2003; Spiro et al., 1992). For one, the ability of individuals to move out of a state of acclimation or naiveté in any field is predicated in part on their level of neurological and biological development; that is, the mind and body must be at some sufficient level of maturation or experience to benefit from any potentially educative event. Also, there are characteristics of the learner (the who) that become relevant in such development in that individuals may be more
or less predisposed to the neurobiological, physical, cognitive, social, and motivational demands associated with any particular domain. That is why individuals can be positioned at significantly different points in expertise development for each and every complex domain. The same person may well be acclimated in physics, competent in statistics, but expert in linguistics.

Moreover, the human and non-human resources that individuals will require will shift as they gain facility in the domain and as central principles of the domain become part of their knowledge core. Of course, it is also assumed that the journey toward expertise means that the objects of learning become increasingly more complex and that the processes and products of learning mirror that growing complexity. Also, it is well documented that the attainment of expertise in any complex domain requires an extended period of time, many thousands of relevant exposures, and the tapping into the knowledge of others (either with or without their explicit support and guidance) who have likewise attained expertise in that domain (Ericsson & Smith, 1991).

**Learning Defined**

Now with the principles and dimensions of learning in place, let us forward a definition of learning that operates in concert with those principles and dimensions.

Learning is a multidimensional process that results in a relatively enduring change in a person or persons, and consequently how that person or persons perceive the world and reciprocally respond to its affordances physically, psychologically, and socially. The process of learning has as its foundation the systemic and dynamic relation between the nature of the learner and the object of the learning as ecologically situated in a given time and space as well as over time.
Within formal logic, it is considered essential not just to establish what a thing is, but also what that thing is not (i.e., antinomy). Similarly, we think that our definition of learning would be incomplete if we were unable to specify what learning is not. The principles that we previously proffered serve us in this endeavor since certain characteristics of “not learning” are implicitly or explicitly stated within those principles. First, all innate capacities, those inborn, genetically and biologically programmed aspects of our humanness, influence learning but are in and of themselves outside the parameters of learning as we have conceptualized it. Second, and related to the issue of innateness, the biological/neurological maturation of the human organism in and of itself does not constitute learning. Third, just recalling that which was previously learned that does not constitute learning per se. Only when recall results in some new configuration or change does it reach the level of learning. Finally, as sensory beings, we are in continually physical contact with the world around us. Yet, unless those continuous sensorial experiences leave some relatively enduring footprint, it does not fall within the realm of learning as we have defined it.

Touchstone Cases

It is easy when dealing with fundamental constructs that describe human functioning to remain at an abstract level that does not allow for a valid test of notions against the complexities that a real learning situation would bring with it. Learning is often so associated with formal instructional settings that it is easy to forget how ubiquitous it is. Testing our developing notions about learning against different kinds of real-world situations challenged us to see whether our views were broad, comprehensive, and justifiable. The three examples we chose involve different kinds of learners, each learning something at different levels of complexity in different contexts of place and time. For each case, we attempt to establish why it represents learning and
how it sits at the nexus of the dimensions within our topographic map. Where relevant, we discuss how previous conceptions of learning have focused on the kind of learning represented in the case, or not.

*Case 1: Biting into a Cherry*

When Diane’s elder son, Robbie, was barely two years old, he had acquired some degree of experience with eating an array of “adult” foods. One might even say that he was skilled at bringing a spoon up to his mouth and swallowing yogurt or cereal he had scooped onto it from a bowl. Yet, it was a relatively frequent occurrence that he would face some new substance and would have to learn about it, not only whether it was edible but also such characteristics as how it looked, how one should hold it to eat it, what to do with it in the mouth, and how it tasted. On a particular hot Texas day, Robbie grabbed one plump cherry as his mother looked on, popped it into his mouth, and bit down. What made this small insignificant step in “cherry-as-foodstuff” knowledge acquisition memorable was the look of sharp surprise he displayed as his teeth met the pit of the cherry straight on. It was clear that he had not “predicted” a cherry pit and that he did not, in some essential way, know how to eat a cherry. Where an adult carefully, albeit often automatically, negotiates the teeth around the center of the cherry and squeezes down making sure that the juice of the fruit stays inside the lips, Robbie had bit hard into the center of the cherry and had made bright red juice spurt out down the front of his t-shirt. Even by his second cherry, he was more cautious in biting, more careful about the mess of the juice, and more eager to reproduce the taste of the fruit. He had learned how to eat cherries, or more accurately, how not to eat them, adjusting his teeth and lips so as to avoid painful effects.

According to our emerging model of learning, Robbie was developing a simple set of acquired actions (habits) and responding to the effect of the punishing stimulation coming from
the pain of biting into a hard substance and of spoiling his favorite t-shirt with red cherry juice. What he had to learn in this situation—how to chew and how to position his mouth with this new food—could not easily be acquired by imitation as most of what needed to be discovered was hidden from view. Yet, his own physical sensations could “teach” him what to do in this case.

Because Robbie was learning in a particular context, represented by the physical environment (e.g., the objects on the picnic table on the family patio, the presence of his mom and dad, the smells and tastes of the food, or the bad pain of having bit into it wrong) and the sociocultural context (e.g., that his family loved cherries, that they saw them as a treat, or that they ate them directly out of a bowl) influenced whether he would want to have a cherry again, let alone know how to eat it. His learning was shaped by who he was as a learner of cherry eating, his motives, likes, ability to figure out how to position body parts so as to avoid pain and gain tasty sensations, current level of maturation and knowledge development about this small domain, favored status in his indulgent parents’ eyes, and a host of other characteristics that made him learn as he did on that particular occasion. And finally, because of his age and the number of times he had previously eaten a cherry, a trajectory to his learning could be envisioned even then. Now at the age of 30, Robbie can eat cherries with the best of them.

The acquired habit and conditioned response this small child had learned would be immediately understood by a learning theorist coming from a behaviorist perspective, although the details of context, personal motives, and interpretations of the experience would likely be unnecessary and distracting. Such a view might even downplay the importance of the maturational level of the learner as it placed emphasis on the feedback loop created by the pain sensations (and in less restrictive versions of the theory, the frustration of having spoiled a favorite shirt) on the acquisition of the proper behavioral production routines. By contrast, a
sociocultural view might emphasize the meaning of a family picnic as a context to a child being introduced to a new food while overlooking, perhaps, the working out of the proper lip, teeth, and tongue movements required in eating a cherry properly. A cognitive-constructivist, on the other hand, might employ this case to illustrate the manner in which Robbie’s lack of experience and his still emerging schema for fruit-eating led to the undesired event and how this particular experience would likely add salient information to his mental model for cherry consumption.

Case 2: Crossing the Via dei Fori Imperiali in Rome

In the second case, we describe what happened when Ralph, on a first visit to Rome, had the occasion to “cross” one of the major streets in Rome. Taking off on foot from the hotel, he had already spent several hours navigating the ruins of the old Forum when he decided to visit the Piazza Campo de Fiori. Nothing particularly remarkable happened as he crossed several smaller streets on his way but then he came to an extremely large street, Via dei Fori Imperiali, six lanes wide with vehicles crowding every lane and moving at a daunting rate of speed.

Although critical elements of Ralph’s well-learned, American street crossing schema did not seem to apply, they did guide his attention in the search for a solution—a process that in this rendering may seem much more protracted and analytical than it actually was. First, he looked for a streetlight that would stop the traffic, immediately ascertaining that there were none in sight. Next, he looked for a corner from which to cross, only to discover that while some corners did indeed have pedestrian crossing markings, the people driving the cars seemed to pay no attention to them, never stopping or even reducing speed. Hesitating as to what to do next, he noticed that the native Romans were crossing the street, albeit quickly and with great agility, by simply wading into the traffic, crossing one lane at a time whenever even the smallest traffic gap occurred, standing on the lane marker when their progress stalled, and moving ahead when
another opening came. The only people stuck on the curb seemed to be tourists. He watched for another minute, launched into the traffic crossing as the natives had crossed, and soon found himself on the other side of the street.

Some of the same well-learned motor and sensory-perceptual skills acquired as part of his American street-crossing schema had served him well. However, Ralph had learned a host of new things about crossing a street from his experience in Rome, changes in how he should propel himself, staccato-style, across the street, attitudes about stepping into traffic, signs that it was acceptable to force himself into traffic in this way, and appreciation of the drivers’ skill in maneuvering around pedestrians. In this new context, the how of crossing the street certainly had been changed. The speed with which he had learned the new procedure was remarkable, reflecting some of his abilities as an athlete and his sang-froid in a new situation. By the time his wife Bonnie joined him from the States a few days later, he had become extremely adept at crossing the street and was surprised at her reluctance when he tried to take her hand and help her cross the street, Roman-style. She reacted by pulling her hand out of his with a look of alarm and resolutely remained stuck to the curb watching him show off his newly-acquired skill. With all the differences between them relative to this particular learning occasion, it is perhaps not surprising that Bonnie resisted somewhat longer in adopting the “Roman” street-crossing routine, but eventually she too came to see this response as necessary and not as life-threatening as she initially thought.

To us, this case of crossing the street in Rome is a useful illustration of learning for multiple reasons. For example, we see that the what of the learning has many of the features of spontaneous concepts and actions discussed earlier. Being nested in the current physical and sociocultural context of Rome and heeding the movements and behaviors of those around him
proved sufficient for Ralph—an experienced traveler—to master the art of Roman street crossing. No formal instruction in this process was sought, and none was required. In terms of the where dimension, it is quite evident that these pedestrian conventions were not broadly generalizable, but rather more closely tied to a given local context. Try crossing a street in Los Angeles, New York, or London in the Roman way, for instance, and the disaster anticipated by Bonnie would become a real possibility. Still, there is every reason to assume that Ralph and Bonnie will not soon forget the routine they acquired, and this durability is further evidence that learning had, indeed, taken place.

Different aspects of this case would likely be appealing to those holding to diverse perspectives on learning. For situated cognitivists, for instance, Ralph’s reading of the immediate context and of the affordances that the context provided would be intriguing. How and why Ralph responded as he did at that given moment would be of particular import. Conversely, a socioculturalist might be drawn to the street crossing routine as an aspect of the sociocultural milieu that a “foreigner” might need to adopt in order to function within this environment. In this view, the focus might be on the co-regulations occurring between walkers and drivers navigating the Via dei Fori Imperiali at the same time. A cognitive-constructivist might be interested in the cultural knowledge that Ralph and Bonnie acquired from this experience, and how each of their existing conception of street crossing interacted with the new experience and was changed, either moderately or radically, as a result of this memorable occasion. An evolutionary cognitivist, by comparison, might be fascinated with the way in which Ralph, as representative of his species, had learned to deal neurologically with the myriad of stimuli bombarding him in this modern urban setting, and his ability to respond adroitly to the sophisticated pattern of stimuli in a manner that ensured his survival and achieved his goals.
Case 3: Learning to Write an Academic Paper in a New Discipline

In our third case, we focus on the critical task that students face when admitted to graduate school, learning how to write for the publication outlets in their field. With this case, we consider the acquisition of the most complex form of knowledge, scientific concepts and practices. Many analyses of this process are available in composition studies. For example, in a classic piece, Berkenkotter, Huckin, and Ackerman (1988) described the history of Nate as he experienced the sometimes painful transformation of losing the style of his English literature undergraduate major and acquiring appropriate ways of conceiving of evidence and presenting it adequately for a social science academic journal. As Nate reported, there was a period of time during that first year of his academic studies when he felt that he was losing himself even as he was learning what to attend to and how to write about it that made up his new discipline.

Similarly, reporting on years of intensive observation and disciplined analysis, Fox (1994) delineated the difficulties that international students experienced as they learned not only to adopt the style appropriate to their discipline but also the ways that feedback about writing was provided in this country, self-confident, direct, even abrupt. Prior (1995) documented the processes in which a new graduate student engaged as she learned to write a conference proposal with her major advisor, at first simply taking every suggestion as a sign that her advisor knew so much more than she did about what to say and how to say it in the proposal. Slowly as she continued to work with her advisor, she acquired the knowledge of current issues in the field, the language appropriate to their expression, and the confidence to resist at least some of the advisor’s suggestions as she came to care about what was being said.

Because it is not difficult for us who have had students and who can still remember what it was like to develop as writers in the field, we can test our emerging model of learning against a
somewhat generalized case here. We consider this progression in graduate students to be learning because students’ abilities to write are significantly transformed over the span of a few years. Learning seems clearly evident when graduate students move from turning in their first course paper to the point of writing a first-authored or sole-authored publication. When they graduate, they eventually find they can use the knowledge they have acquired in graduate school to guide their own students in the process of academic writing even as they continue to learn their craft.

What it is that a graduate student is learning about writing includes some aspects that may be simpler to master (e.g., style of citation format), as well as more subtle and difficult conventions for deciding how to frame an argument, who to cite when doing so, what stance to indicate vis-à-vis a particular finding, and when to deem any particular section of a paper as “done.” For instance, what Nate had to learn was how to deploy the cultural practices of his field in his own writing. Those practices reflected historically situated and continually evolving conventions that the domain, represented by advisors and editors, would accept as close enough to the “right” way to write.

Where Nate was learning to write for his field, a field that was itself in the midst of change, was not only in the office of his advisor but in the myriad of hours spent reading the literature and writing apprentice-like essays. Who he was as a learner in the early stage of his academic studies influenced how he interpreted information about writing and the degree of investment he put into his development as a writer. Once he had made some progress in his path toward becoming a writer, he could begin to have some small degree of influence on the field, eventually becoming a recognized young scholar whose ideas influenced others.

It is hard to imagine what facets of this complex case a behaviorist would find informative or appealing, except perhaps to focus on the relation between the feedback Nate
received and the accolades he was given (e.g., co-authorship) as critical reinforcement that would sustain his efforts over the years. To a cognitive-contextualist, Nate’s journey toward expertise would prove especially compelling, particularly in terms of the transformations in his knowledge, problem-solving, and motivations that would unfold over the developmental course. Perhaps for the socio-constructivist, the scaffolding invited by Nate and provided by his advisor and other knowledgeable others during the graduate school experience would be the point of analysis in this learning case. To the cognitive-evolutionist, areas of interest would include Nate’s ability to adapt productively to this new situation, to set viable goals, and engage in activities to achieve them, to use his background knowledge and innate capacities to understand and instantiate what he was learning. Of course, the outcomes of this learning and Nate’s success in his new field would enhance his ability to procure the necessities of survival, within a suitable academic institution. A socioculturalist would be interested in describing how Nate appropriated the cultural practices of the field (i.e., became enculturated) even as he changed not only the local culture of the program but also, eventually, the wider culture as he achieved greater status within his field.

Concluding Thoughts

There were many reasons why the three of us first embarked on this challenging and risky expedition to map learning’s landscape. As we noted at the outset, the construct of learning has been comfortable territory for each of us for decades. Yet, we thought that there was much about learning that we had come to take for granted or that we simply had overlooked, sidestepped, or even avoided in the course of our daily excursions. Further, for all our philosophical and psychological differences as educational researchers, we concurred that there was something out there that we were missing, something that compelled us to pack up our
collected wisdoms, our beliefs, and our biases and at least set out on this mission to chart the
topography of learning.

By embarking with those who viewed the terrain differently, we hoped that we could be
prompted to see what we had individually overlooked or be urged to visit empirical and
ontological places that were too daunting to visit alone. Yet, for all the exertion, we recognize
that the resulting mapping is but a starting point, as first mappings must be. What becomes of our
charting is dependent upon factors that may well be outside our control, such as whether others,
especially those who perceive the landscape differently, will feel the wanderlust we experienced
and similarly embark on such a mapping expedition; whether the tools and equipments required
to probe wider and deeper into the learning landscape are currently available or will be forged in
the near future; and whether the dynamic and ever-changing nature of the learning system in
reality condemns us to a Quixotic quest for the unattainable.
References


Mahwah, NJ: Lawrence Erlbaum Associates.


Figure 1. The levels of complexity within the *what* dimension of learning

- **Inborn Reflexes**
- **Acquired Habits and Conditionings**
- **Spontaneous Concepts and Actions**
- **Scientific Concepts and Practices**