Distributed Learning: Definitions We Can Use
Libby Hemphill
December 2005

Introduction
Distributed learning is a perspective on all learning; we proposed distributed learning as a “perspective on learning that examines the distribution of learning in space and time and the mediation that crosses that distribution” (Jim Levin, personal communication). This perspective seems, on its face, to make sense. It seems reasonable, given personal experience and experimental findings, that context matters for learning, and that an environment plays a crucial role in learning. What we have not figured out about distributed learning is what aspects of environment to study, how to describe the relationships in the environment, and how to tell when learning has occurred — in short, how to measure it. Our class struggled to define learning in general and distributed learning in specific. We managed to develop a rather broad definition (given above), but such a definition, however, is slippery: what does it mean for learning to be distributed in time and space? What is mediation, and how does it impact learning? Our definition lacks explicit variables that would allow us to measure learning or its distribution; our definition even lacks a statement of what learning exactly is. We need a way to study distributed learning that tells us what is not learning and what about distribution impacts learning.

In attempt to grasp what it means to study the distribution of learning in time and space, mediation in time and space, and even “learning” generally, this paper will explore concepts and constructions from Actor-Network Theory (ANT) and structuration theory. I will argue that ANT and structuration have insights to offer studies of interactive scenarios like those referred to by our definition of distributed learning. Using these theories to define entities in an interaction could allow us to operationalize variables so that we can measure changes in these interactions over time. By allowing us to measure change over time, these theories may allow us to study learning even within our slippery definition.

First, I will describe the dichotomies of modern thought to which ANT and structuration are replies. Distributed learning is itself an answer to dichotomies such as “in the world” vs. “in the head,” and these characterizations are central to all three perspectives. Next, I will describe the concepts from ANT that apply to an endeavor to understand learning as a distributed process. The third section will explain what structuration has to offer this activity. Section four will provide an example of how these theories can be used together to produce measurable variables within scenarios that could enable us to study learning distributed in time and space.

Dichotomies and After
ANT describes society as a collection of actors, human and nonhuman, tied together in networks aiming to achieve a common goal (Stalder, 1997). This view rejects the traditional agent-structure dichotomy on which much of modernity relies. ANT belies other distinctions as well, including stimulus-response and subject-object. In all these dichotomous models, a subject or structure (some nonhuman thing) that acts upon an object or agent to produce a response. The agent’s role is somewhat passive; she simply absorbs the stimulus and responds. We can see analogous dichotomies in historical approaches to thinking about learning.
One such dichotomy is inside the head – in the world. Some theories of cognition and learning, such as information processing have argued that learning processes take place solely within the head of individuals. In these theories, humans perceive information contained in their environment; that perception triggers interaction with a central processing mechanism within the brain; that mechanism communicates with various memory stores; and the process results in instructions to the motor faculties. Here, we would say someone had learned when their motor response changes. For example, an individual learning about poker would be said to have learned when she makes a previously unseen move when presented with a similar betting situation multiple times.

Other theories of learning have offered explanations of how this change in behavior is produced. This section briefly introduces information processing and situated learning as theories upon which distributed learning builds. Information processing is wedded to the “inside the head” vs. “in the world” dichotomy. Information processing requires an impoverished notions of the role of environment in learning; it claims that the head is the site of cognition and that the environment matters only as a set of inputs for the internal cognitive processor.

On the other hand, theories of situated action explain findings that suggested the environment affects cognitive behavior, including learning. Lave and Wenger argue that learning is actually a function of the environment in which it occurs (Lave and Wenger, 1991); in this view, learning occurs as one becomes more active an engaged in a community of practice. The community values certain beliefs and behavior, and those are reinforced through activity within the community and its culture. This theory is able to incorporate findings that demonstrate different behavior in different environments and at different times, but it does not provide ways to measure and track those changes reliably.

Distributed cognition is an extension of this information processing – situated action project. Information processing responded to behaviorism by focusing all cognitive activity inside the head instead of focusing solely on external behavior (Hutchins, 1995). Situated action offered environment as an important factor in determining what kind of cognitive activity can take place. Distributed cognition includes the environment in the cognitive system. Environment and context are no longer just limiting spaces or situations in which learning takes place; they are active participants in the process of cognition and learning.

Characterizing learning is this manner, as an activity that involves humans and their environments, makes it difficult to identify the moment at which learning occurs. Our seminar group defined learning as “the changes in knowledge, skills, and attitudes that occur in individuals, groups, and institutions as a consequence of activities distributed in space and time facilitated by a variety of mediators” (Jim Levin, personal communication). It is difficult to operationalize the variables this definition requires. We can draw measurable boundaries around individual, group, and institution, but we have not mastered how to categorize or measure changes in knowledge, skills, and attitudes that occur within those boundaries.

I argue that actor-network theory and structuration theory offer us the tools to operationalize variables, such as knowledge and attitude, by depicting these learning systems as actor-networks in which each actor has the kind of agency defined by structuration theory. The rest of this paper will describe how to develop an actor-network, explain why Giddens’ definition of agency is required for
understanding distributed learning in terms of actor-networks, and make some guesses as to how this approach to distributed learning research could be used.

The Basics of Actor-Network Theory

Law admits ANT can be thought of as a theory of knowledge (Law, 1992). ANT casts knowledge as the result of hard work by a variety of agents; for example, Law describes a classroom in terms of an actor-network where the instructor, the students, and the overhead projector are actors. Note that within ANT, actors need not be human. The overhead projector is part of the network because it participates in the interaction; it helps to define the teacher-student relationship, to amplify information the teacher thought was important, and influences the way the other actors behave in this situation. Using this example, this section will illustrate the concepts actor, network, and intermediary.

Actor

An actor consists of a thing and its competencies (Stalder, 1997). In the example of a classroom, it’s easy to understand the teacher and students as actors. We’re used to ascribing competencies and capacity to humans; in this example, the competencies teachers and students differ from one another. It may be unfamiliar to think of a machine, in this case an overhead projector, as possessing competency. However, as Law’s example illustrates, the overhead projector plays crucial roles in constructing the classroom environment. Its presence helps establish the authority of the teacher; its ability to project enables the teacher to highlight some information at the expense of other information. Latour describes these actors as “entities that do things” (Latour, 2005). To sum up our example, the teacher teaches, the students pay attention and take notes, the projector helps define roles; each is an entity doing something in the scenario.

However, the human on its own is not necessarily an actor. When defining actors generally, Law reminds us that actors too are networks; actors are made of heterogeneous relations, hence the hyphenation in actor-network (Law, 1992). For example, I would not be the same if you took away my PowerBook, my office, my students, etc. I, as an actor, am the product of my heterogeneous relationships to these things.

Network

“Network” is a misleadingly straightforward term. We have a sense of network as technical infrastructure or collections of individuals in social environments. More broadly defined, a network is a “group of unspecified relationships among entities of which the nature itself is undetermined” (Callon in Stalder, 1997). When describing a specific kind of network termed a “social network,” Wasserman and Faust define networks as sets of actors and the relations defined on them (Wasserman and Faust, 1994). For ANT, a network need not include only social entities. In fact, ANT counters the notion of social as something that can act on an entity; instead, it is an adjective describing a property of an entity. ANT argues that there is no “social” that exists outside individuals but rather that social is not a special domain but a movement of re-association and reassembling (Latour, 1999 and 2005). If we use the definitions of “network” that Callon and Wasserman and Faust provide, and combine them with Latour’s notion of “social,” we arrive a definition that describes networks as actors connected by relationships where those agents and their relationships...
are constantly re-associating and reassembling. This understanding of “network” closely resembles meaning of the term used most often by ANT theorists.

To connect this definition to Law’s example of the classroom, we can understand the classroom itself as a network. We have identified at least three actors – teacher, student, projector – and we have an intuitive understanding of relationships that exist among these actors. What we are missing is an understanding of how those relationships are established and maintained. What networks do give us are a set of measurable properties and testable hypotheses: centrality, betweenness, closeness, and isolates are four important concepts we gain from general network theory. I’ll describe these terms briefly.

Centrality describes the degree to which any node in a network is connected to other nodes. In our networks, this would measure how closely tied actors are to one another. At least two types of centrality are measurable: degree and betweenness. Degree centrality tells us the number of connection a given node possesses. Betweenness tells us about those connections; do those connections connect otherwise unconnected parts of the network? Closeness measures the length of paths among nodes; the length of a path is the number of connections one must use to move from one node to another. Two nodes are close if they share a connection or are just a couple connections apart. Isolates are a special kind of node. Isolates do not connect to any other node within the network. Their presence indicates that something is lacking from the network or tell us something about the isolate itself. Mathematical analyses are available to measure these properties of nodes and networks; statistics lets us compare these analyses for significant differences. We’ll return to these ideas of measurable variables in the example that concludes this paper. Next I describe another concept important in ANT: intermediary.

**Intermediary**

The previous sections describe ANT’s definitions of actors and networks. Actors are entities that do things; networks are those actors and their relationships. The last concept that is central to ANT and applies to our discussion of how to use ANT to study distributed learning is “intermediary.”

An intermediary is a thing passed between actors that defines their relationship (Stalder, 1997). Actors use intermediaries to convey messages to other actors. In our classroom example, some possible intermediaries are texts and the teaching itself. Text plays a special role because it too can be an actor-network. For a discussion of how text can be understood as such, please see Law. For the purposes of this paper, it is enough to understand that text can send messages, can stand in for human actors, and can motivate action – all indicators that it can be consider an actor. Here though, we can understand a text as an intermediary. Any text the teacher provides her students passes between those two actors in the course of a stable transaction; this stability of transaction is a condition of intermediary (Bijker, 1992).

**Collecting ANT’s Terms**

Actor, network, and intermediary are all central terms to actor-network theory. The definitions put forth in the previous section are significant because they ascribe capabilities to nonhuman entities,  

---

1 For a more thorough description of these terms, see Wassernman and Faust or http://www.orgnet.com/sna.html.
recognize (even demand) the fluidity of relationships among humans and nonhuman objects, and establish the boundaries for the development of those relationships. It may seem like we could stop our project here, and begin to define distributed learning in the spirit of Law’s definition of knowledge as an actor-network. Let’s take a moment to examine what such a definition would look like, and uncover what it would lack.

ANT’s definitions allow us to broaden our understanding of actor to include nonhuman things such as text, institutions, even projectors. Such a broadening is essential for a perspective on learning that denies that “in the head” is the best place to locate learning. By allowing other entities to be considered in scenarios, ANT provides the distributed learning perspective some support. However, defining distributed learning as changes in an actor-network over time would be meaningless; it wouldn’t tell us anything we did not already know. One central property of an actor-network is that it is constantly re-assembling and rearranging; change is a necessary condition of an actor-network. For ANT to be useful in studying distributed learning, it needs to tell us specifically about the changes in knowledge, skills, and attitudes of those networks. Unfortunately, ANT cannot do what we’ve just asked. ANT can describe for us the actors involved in a scenario, and even extend that definition to include nonhuman actors such as projectors or texts, but it cannot describe how or why the changes in these networks happen—except to say that intermediaries facilitate the change. The next section will describe concepts from Giddens’ theory of structuration that can fill in these holes.

Including Structuration

Like ANT, structuration denies that any concept of “social” exists beyond the individual. Instead, structuration purports that society and the individual react to and reconstruct one another; either cannot exist without the other (Giddens, 1984). Both theories are also responses to the theoretical dichotomies at the beginning of this paper. Structuration rejects the agency-structure, subject-object dichotomies as well. Instead of focusing on such dichotomies, structuration theory emphasizes social practices generally (Giddens, 1984).

The concepts central to structuration that apply here are agency and structure. Giddens expands the definitions of both terms from the modern dichotomy, and in doing so, provides us tools with which to think about and study distributed learning.

Agency

For Giddens, power to effect change is central to agency. To have agency, an actor must be able to influence any given state of affairs (Giddens, 1984, 14). Giddens restricts his discussion of agency to human actors; this is necessary because he ascribes reflective quality to agents. Agents are constantly creating theoretical understandings of their contexts, and this activity requires a kind of cognitive process Giddens would not ascribe to nonhuman objects. Agents have general motivations and intentions, and they are competent when able to act in accordance with those intentions.

For our purposes, we need not accept all aspects of this definition of agency. Because ANT provides for nonhuman actors’ abilities to play roles in networks, we need not accept that interaction requires reflexivity. However, structuration’s “agency” does provide more detail about the nature of capabilities that is useful. ANT defined actors as entities that do things, things that have capabilities. This description is not sufficient for our purposes, and so we turn to structuration’s “agency,” which defines agents as entities that are capable of influencing their contexts, of effecting change.
Change is central to the definition of learning on which we rely, so it behooves us to take note of its presence. To study learning effectively, we need to be able to account for change, and with the help of structuration’s definition of agency, we are part way there. This definition of agency tells us where to look for the instigator of change, the independent variables that are able to produce changes in dependent variables. Using ANT’s concept of actor and structuration’s concept of agency, we can locate the power to change in human and nonhuman actors. This supplies the “what” and “who” for our exploration of changes in the knowledge, skills, and attitudes of individuals, institutions, etc. Next, we get some hints about “how” from structuration.

**Structure**

Giddens outlines three analytical structures: signification, legitimation, and domination. Signification structures establish meaning through symbols or signifiers such as language and language practice. Legitimation structures produce meaning through order and norms. Finally, domination structures produce power and control resources. One way to understand these structures is as vectors that pass among individuals, and between individuals and society. Structuration, unlike ANT, does not reject the idea of a distinct social entity. Rather, structuration asserts that the social cannot exist without the individual and vice versa. ANT’s more radical position is that “social” is not a distinct concept. Returning to the vector analogy, however, will allow us to connect elements of structuration and ANT.

The three kinds of structure provide interaction between individuals and society. Both, in turn, provide signifiers, legitimacy, and dominance to one another. Without individuals, society can have no legitimacy or domination, and its symbols would be meaningless. Similarly, society provides legitimacy and domination to individuals and assures them that their symbols will be meaningful to some entity beyond themselves.

**Incorporating Structuration**

So what do these definitions of agency and structure do for us? The definition of agency provides concreteness lacking in ANT’s definitions of actors. By ascribing agency, in the way structuration theory defines it, to actors, we are able to understand just what kind of capacity actors possess – the capacity to produce change. For now, we’ll leave change ambiguous and let it suffice to say that agency matters because it indications production of change, not just ability to do things but to actually change things. Because we have included “change” centrally in our definition of distributed learning, it is important to identify that actors have capability to produce change – actors have the capacity to learn.

However, capacity to learn does not necessitate learning. Here, we can use ANT’s definition of networks and structuration’s delineated structures to understand just how change manifests. ANT provides a definition of network – relationships among actors – that establishes a framework for understanding where structuration’s structures develop. By exchanging intermediaries, actors establish networks, and these intermediaries are the resources that establish signification, legitimation, and domination. Intermediaries are exchanged in stable transactions, and structuration assures us that the interactions among individuals and societies are stable and recurring. ANT tells us that networks are constantly changing, and structuration tells us how. Networks change by establishing signification, legitimation, and domination. The interaction of these structures produces change, and this change can be represented in networks. The next section will describe how structuration’s three dualities of structure enable and inform ANT’s dynamics of actor-networks to
produce measurable changes. These measurable changes are central to the effective evaluation of learning in a distributed perspective; without a way to measure change in the interactions we claim as central to learning, we cannot effectively test our hypotheses about learning as a distributed endeavor.

**Structure and the Dynamics of Actor-Networks: Getting ANT and Structuration to Work Together**

In order to understand how these concepts of actor, network, and agency can work together in studying distributed learning, let’s look at an example. This section will outline an actor-network-structuration explanation of a situation in which learning has clearly taken place. My hope is that in explaining this obvious example that we will be able to see how this approach can be used to study other, less apparent instances of distributed learning.

**Learning at the Poker Table**

A poker table is an easy place to see evidence of learning. When a table opens, from 4-10 players and one dealer sit down, stack their chips, and begin to play. The game involves knowledge of probability, statistics, psychology, and specialized language. We can see evidence of learning because the way a player plays her first hand at a table is very different from how she plays her later hands. The particulars of the game are not important for this example; suffice it to say that success in the game depends on knowledge in those areas just mentioned. What is important for our example is to understand what influences the development of that knowledge, and I will use the concepts discussed in earlier sections to describe these influences and how they operate.

**Actors and Intermediaries**

The line between actor and intermediary is somewhat blurry. Actors can be intermediaries and vice versa. A poker chip is a good example of this trickiness. When a chip is used in a transaction, as an indicator of a player’s bet, it is an intermediary; intermediaries are used in the stability of transactions. A poker chip alone can also be an actor; like a monetary coin away from the poker table, a poker chip serves as “a standard measure value and a mechanism for exchange” (Stalder, 1997). In our example, the chip is a mechanism for an exchange in a stable transaction of poker betting. This betting is subject to strict rules, and those rules provide stability for the transactions that take place at the table.

Players, cards, and the dealer are also actors as we defined them earlier. Remember, an actor is an entity that does things. In this example, players move chips around, make betting decisions, give tells (mannerisms that indicate their card strength), and converse. Actors are necessarily tied up with representation (Latour, 2005), and the cards demonstrate this. They represent another measure of value, like chips, but are not part of an actual exchange. Rather, they act as representations of the players' position in the game. Their actual value is determined by the player who holds them, the other cards in play on the table, and the betting that occurs. Lastly, the dealer is an actor. The dealer provides information about the rules of the transactions, controls the dissemination of cards, and is responsible for maintaining control at the table.
Networks
Networks are entities and their relationships. In this poker scenario, the actors are connected by their chips, their shared use of the deck of cards, and their physical co-presence (online poker would unnecessarily complicate our example). The relationships develop as chips pass around the table, as players engage in smaller heads-up games (all other players have been bet out, just two remain), and as players talk to one another and to the dealer. This network is also part of a larger network that includes the casino and poker generally, but both of those are outside the scope of the example.

Agency
Structuration defines agency as the capacity to create change. The same theory would not normally ascribe this property to nonhuman objects. However, given our understanding of actors from actor-network theory, we can understand how a nonhuman actor like a poker chip can possess the capacity to create change. At a normal poker table, the poker chip has the capacity to change the network described above. When used in a transaction, the chip changes the statistics players need to use in their calculations of risk; when stacked near a player the chip changes the impression other players have of the possessor (more chips lead to more intimidation). The other actors at the table can also change the network – players can choose to share strategy or anecdotes with some but not others, the dealer can set the pace at which transactions take place, the cards give power and quickly take it away.

Explaining the Table
To understand how all these terms go together, and how they can help us study distributed learning, we should first revisiting what learning and distributed learning meaning. Our class defined learning as change in behavior or state and offered distributed learning as a perspective on all learning that examines its distribution and mediation in space and time. I argue that changes in state and behavior occur for individuals and the poker table itself throughout a game. First, individuals change their betting behavior. The table as a whole changes it state; people come and go, chips move around, the average aggressiveness of bets fluctuates. These changes are observable, but our example explains how they come about.

I'll focus on explaining how the changes in individual behavior come about. When an individual arrives at the poker table, she brings her past experiences and statistical knowledge with her. She most likely has some familiarity with poker chips and playing cards, but the human actors at the table are unfamiliar. Throughout the course of the game, her relationships with those actors – chips, cards, and people – change in ways we can measure. We can easily track the movement of chips around the table. We can track the conversation turns that take place. We can even keep a history of the cards that she sees and the bets that take place at the table. With all of this information, we can create a series of diagrams that depict the network of the poker table.

Once we have the information coded into a network, a set of entities, their attributes, and relationships, we can perform statistical and qualitative analyses that weren’t possible before we constructed such networks. We can measure the betweenness, centrality, and position of each actor in the network; we can uncover relationships’ start and end points as well as track their strength over time. This data explains how, through the changes in relationships of actors with agency, observable changes in player behavior result.
Conclusion

What this example of the poker table provides is a place for us to witness changes in behavior of individuals and groups over time and space. According to our distributed learning perspective, this is exactly the kind of behavior we want to study and explain. However, without specific definitions of the individuals and entities in a distributed learning system, we cannot measure the changes in behavior that indicate learning. By borrowing the concepts actor, network, and agency and their explanations, we can conceptualize a distributed learning system in entities and relationships whose properties are measureable.

We can generalize the poker table example to other systems in which we want to determine whether or not learning as occurred, and if it has, explain how it did. For example, we can use the charter school case study from our seminar. The schools described by the researchers at San Diego were presented as a study of organizational learning. According to our seminar’s definitions of learning, in order to say organizational learning has occurred, we need to present evidence of changes in states and behavior. The policies and test scores of the organization demonstrate these changes, but how they came about remains unclear. Were we to describe the organization and its surroundings in terms of an actor-network and to ascribe agency to those actors we can identify, we may be able to measure the relationships and changes that produced (or at least correlate highly) with the observed changes. These network statistics may not give us proof of a path from before learning to after learning, but they can certainly provide a plausible explanation of that path than can actually be tested.

The NSF review and this paper’s introduction both hinted at a important problem with distributed learning’s perspective: it’s unclear what is not distributed learning or what doesn’t fit in its perspective. This is problematic for our new theory because “if a theory explains everything, it really explains nothing” (Paul Edwards, personal communication). If we cast distributed learning as the study of actor-networks and their changes, we exclude theories such as information processing that deny the connections that are central to actor-network thinking. We also gain the ability to measure and test changes in quantitative ways, and these allow us to explore the relationships of variables – actors, relationships, intermediaries – in testable ways. With this framework, we can provide some quantitative traction to our theory that lends it even more credibility than the “try it, you’ll like it” approach we seem to have been using.

References


