The learning teacher: role of ambiguity in education¹

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Abstract: Life is full of ambiguities, but as teachers we generally try to teach our students in a manner that sanitizes knowledge of all of its ambiguities. In doing so, we create an educational environment which forces students to learn in a rather meaningless fashion and this in turn leads to a lack of vitality and relevance within the academy. This need not be the case. As teachers, we should reflect on the epistemological foundations of our theories of learning and teaching and to closely examine how our teaching devices and techniques adhere to our theories. Furthermore, we need to be receptive to making any changes in our theories and teaching practice that may be warranted by the critical and creative thinking process that we apply to our professional activities. This paper attempts to guide readers through such a reflexive thinking process by trying to loosely establish a relationship between the deep concept of ambiguity (uncertainty) and some of our theories of learning via the acceptance of the view that the ultimate foundation of all human knowledge is ambiguity. We create and establish the meaning of all of our knowledge via a process of self-referencing *logos*. An implication of the application of self-referencing logic is the notion that a teacher can simultaneously learn and teach (“the learning teacher”). Thus, this can serve as the basis for developing the model of the “reflexive practitioner” in the teaching profession.

Keywords: ambiguity, self-referencing logic, reflexive practitioner

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Introduction

“What a ridiculous topic! Everyone knows that there should be no ambiguity in education. What students learn should be clear and unequivocal and not vague and ambiguous.” How many of you readers agree with these statements? Disagree? Quite interesting, some of you agree and some of you disagree. Also, it seems that some of you are unsure as to whether you agree or disagree. I suspect you seek additional information before you are willing to make a judgement on this issue---a very appropriate strategy. Clearly the results of this informal polling indicate that we are not dealing with simple ideas here. If we were, we would probably have more of a consensus in responses rather than diversity. This lack of unanimity in the polling responses provides the underlying motivation for this paper. We will focus on two concepts, learning and ambiguity, and attempt to provide a comprehensive examination of the possible relationships between the two ideas. The paper will introduce the hypothesis that ambiguity deals essentially with the characteristics of human intellectual perspectives of nature and the self and therefore ultimately does have some kind of role, or influence, on the conceptualization and shaping of the theory of learning. This implies that we are adopting a very wide scope in our inquiry. For example, changing scientific paradigms in the domains of physics and psychology are not outside of our consideration. Nor is learning that takes place outside of the educational structure beyond our consideration in this paper. The possible relationships operate through a multiplicity of intellectual domains. Moreover, much of this role is presently *implicit* rather than *explicit* in the minds of many teachers and educational designers due to their preference for a narrow framework for educational theories. The primary goal of this paper is to try to make it more explicit, that is, to get educators to reflect upon the theoretical basis of their current teaching practices.

How shall we go about achieving our stated goal? Well first of all, as an individual reader, it should be quite obvious to you that my first paragraph is a literary contrivance and not really a factual statement. Unless I can get into the minds of the readers, there is no empirical basis to my claim that there is diversity in the responses. So what's the purpose of this fictional polling result? Is it for deceit? The answer is no. The literary device is for the purpose of setting the theme of this paper. We will be dealing with a wide range of concepts and theories of tangibles and of intangibles. The concepts may have different meaning to different individuals; and different individuals may side with conflicting theories. In principle, this would be sufficient for the diversity in responses that could occur in our polling. The meaning of learning is shaped by a diversity of conceptual and theoretical perspectives

contained in people's minds. It is not the purpose of this paper to side with one model (school of thought) underlying learning over any other model. Instead, the primary aim is to try to shed some insights regarding the manner in which an ambient concept like ambiguity could get incorporated into some meaningful theories of learning and teaching

Secondly, in order to accomplish our stated goal, we need to be careful of the fact that our scope of inquiry is wide but that our focus for gaining insight (or understanding) is quite narrow. Or, another way of putting it is that we would like to express the insights in a local setting rather than a global setting. As an analogy, consider a detailed railway map of Central Europe. You will notice that any particular city, or location, is interconnected with another city, or location, by a network of railways. Thus, to fully understand the implications of a city being an integrated entity you will have to examine the network of railway tracks as well as the nodes (cities). Nevertheless, we could introduce an analytical contrivance for focusing on the nodes (local setting) even though we have some understanding that they are part of a network (global setting). The analytical contrivance that is employed is the distinction among variables that are considered to be endogenous (internally determined) in the analysis being undertaken versus those that are considered to be exogenous (or assumed to be givens) in the analysis at hand.

Loose Framework of Analysis

For the most part, the question of learning has been examined in a local setting rather than a global setting theoretical framework. Learning is associated with education. Although education is just one of many different kinds of human endeavors, such as arts, sciences, engineering, religion, etc., there is a propensity to answer the above question within the context of education itself (local setting) and not the wider framework of life (global setting). While it is understood that learning can take place outside of the educational structure, theories of learning tend to focus on learning that takes place within the academy rather than outside of the academy. This bias towards formal education rather than informal education is quite understandable if you know something about the history of production specialization in many societies. Consistent with the economic theory of division of labor, teachers are said to belong to the profession of education (a specialized channel of production) while other individuals belong to other professions such as: business, engineering, social work, theater, etc. Education is a part (a node) of the social network called a society or a community. Although education is an integral part of a whole, education is studied primarily in a local setting and not a global setting framework.

Let us resort to a sociological concept at this juncture of our discussion. This in turn will conveniently provide us with the opportunity to establish the distinction between the two senses in which we will be utilizing the word “role” in this paper. Within the academy, there are instructors (as well as supporting staff) and students. Simplistically, it is the role of instructors “to teach” and the role of students “to learn”. Thus the roles of teaching and learning basically identify formal education. But just what do teaching and learning entail? What subject is taught (learned)? When is it taught (learned)? How is it taught (learned)? Why the subject is taught (learned) and how effectively is it taught (learned)? Obviously, besides the agents involved, local setting theories underlying educational activities would have to deal with the additional conceptual elements of content, context and assessment also. The diversity of professionally generated (academic) theories of teaching and of learning provides the foundation for educational *practicum*. For after all, educational practices are not conceived and implemented in a conceptual and theoretical vacuum.

The role of ambiguity in learning is clearly *not the same* as the sociological role of a student to learn. The sociological concept of role has the connotation of social expectations. In other words, students are expected to learn and teachers are expected to teach. Not only that, these agents (teachers in particular) are expected to execute their roles in as successful manner as is feasible. [Thus, not only is there a distinct career path but also a system of professional rewards and advancement associated with education.] But by what criteria do we measure success? It is with respect to this last question that we will begin to become aware of the significance of ambiguity in learning (and teaching). Exogenous factors as well as endogenous factors significantly determine success within the framework of a profession. It is this determinant aspect of the concept of ambiguity that is being referred to in this paper as its role. In other words, we are using the term “role” here as a substitute for the more formal language that successful learning is a function of ambiguity (and other factors or variables). If the agents of education do not effectively incorporate more of the external considerations (variables) into their teaching and learning practices, then the results (or outcome) of education will not fulfill social expectations satisfactorily and the profession will be held in ill repute as a consequence.

The Scope and Depth of Learning

Every so often one comes across a really mind-expanding kind of statement or observation. Such an experience happened to me recently as I read a section of Carl Bereiter’s (2002) volume entitled, *Education and Mind in the*

Knowledge Age. In Chapter 8, Bereiter attempts to establish what he calls “a workable distinction between learning and knowledge building.” To begin with, he states:

To head off one potential misunderstanding, we must note at the start that learning accompanies all conscious activity. Therefore learning necessarily accompanies knowledge building. But this does not make them the same thing. Learning occurs while setting out garbage, too, but we do not conclude from this that learning and setting out garbage are synonymous. The learning that accompanies everything we do does not figure in the distinction I am proposing. Rather, the distinction is between activities carried out for the purpose of learning and activities carried out for this other purpose that we call knowledge building. (p. 255)

It quickly occurred to me that Bereiter was attempting to make his distinction on the basis of what mathematicians would call necessary and sufficient conditions, i. e. learning was a necessary but not a sufficient condition for knowledge building. I did not find myself disagreeing with this line of logical reasoning. However, when he substituted setting out garbage for knowledge building, as another example of conscious activity, I immediately found myself disagreeing with him. After some further reflection, however, I realized that at some earlier stage in my life, setting out garbage might have indeed been a knowledge building kind of exercise. But now it has become a routine sort of activity and is not a challenging problem any more, with the proviso that no unexpected constraints are introduced into that activity. If that should happen, setting out the garbage may again become a problematic and not a routine activity. Nevertheless, Bereiter’s discussion made me suddenly realize that a larger share of learning in a person’s lifetime may in fact occur *outside* of school rather than *inside* the school.

A person’s informal (non-academic) learning may be relatively more consequential than her formal (academic) learning. Yet, I find that much of the existing theories of learning are academic-centered and not lifetime-centered. Consequently, there may be a significant misplaced emphasis in some of the existing theories of learning. To some extent, this is being corrected in the development of what are referred to as ecological theories of learning, such as that of David Solomon (2000). These ecological theories manifest more of a global setting view of learning relative to the academic-centered theories of learning. Thus, an asymmetry has arisen between the theories of teaching and the theories of learning. This asymmetry between tea-

ching and learning allows us to make sense of the reference that someone is “self-taught.” It means that the individual has gained knowledge, or learned, about something without the direct assistance of a teacher.

I did not find the rest of Bereiter’s discussion in Chapter 8 to be very elucidating. I think that his introduction of the differentiation of conscious activities into the category of those for the purpose of learning from the residual category of activities for all other purposes (including knowledge building) to establish the distinction between learning and knowledge building is somewhat confusing. His categorization of conscious activities and the utilization of Sir Karl Popper’s (1979) “three worlds” analogy in his elucidation leads me to believe that Bereiter is attempting to make his case (workable distinctions) in terms of a scope and depth methodology. However, his manner of specifying scope does not enable me to make some sense out of a normative statement like: “*We should teach students to learn how to learn.*” When you ask the academician who made such a statement for a rationale or justification, the response is somewhat as follows: “*Because they will soon graduate and enter the ‘real world’ where knowledge is rapidly changing and they need to know how to successfully cope in such an environment.*”

My own thoughts on the scope and depth of learning are expressed in what follows. But since this discussion will be conceptually and theoretically biased, let me disclose my normative perspective up front. I agree with Bereiter on the idea that learning is associated with human cognition, i.e. consciousness. Since consciousness relates to the human mind, it follows that our theories of the mind will have an impact on our theories of learning. However, I differ with Bereiter on the conceptual relationship between learning and knowledge building. He hypothesizes that learning and knowledge building can be conceived of as separate forms of conscious activities, whereas I currently adhere to the conceptual view that learning and knowledge building is a form of complementary cognitive activity. In other words, I believe that our thinking on any content (subject matter) is a reflexive process and not categorically separate cognitive activities.

So where does scope come in? Knowledge is specific to human activities; and we can categorize human activities into various sorts. By virtue of different kinds of knowledge (derived from different activities), we can categorize different kinds of learning but we cannot cognitively separate knowledge and learning. So how would this kind of classification schema work? Consider this example; operating a machine is placed into a different activity category from designing and building the machine. Thus, knowledge associated with operating the machine is considered to be different from knowledge associated with designing and building the machine. And furthermore, the learning of one type of knowledge is distinguished from the learning of the other

type of knowledge. This then could become the basis for dividing education into the sub-fields of vocational education and professional education. So now we can have academies that specialize in vocational education and other academies that specialize in professional education. On top of this type of scope distinction, we can add the distinction that we made earlier regarding learning that occurs within an academy (vocational or professional) from learning that that occurs outside of any academy (on the job learning). Notice that we are beginning to “matrix” scope distinctions.

However, this is not as complex as it could get. We can also make distinctions on the basis of depth, or more specifically, the degree (or level) of complexity. The scope distinction between vocational and professional education implicitly assumes a degree of complexity distinction. This is reflected in the belief that the operator of the machine does not really need to know the design or architecture of the equipment in order to efficiently operate it. Manual and procedural skills are essential but the understanding of blueprints is not. However, something could come along and jolt this existing belief and induce some kind of hypothesis of the sort that knowledge of blueprint reading might significantly improve the operator’s productive efficiency. If this is the case, then we may begin to notice that the boundary between vocational and professional learning has become a little fuzzy as a result of this reassessment. However, the degree of complexity of the knowledge learned need not blur the distinction between formal and informal education. It may require an individual with a very high IQ, but it is quite conceivable that a person that does not have a formal education could learn enough informally to effectively deal with problems in, say, electromagnetic wave propagation in the domain of electrical engineering. Thus, when we explicitly add complexity to our classification scheme we find that we are now dealing with a three-dimensional array (cubic matrix) instead of the two-dimensional one.

So where are we in terms of our assessment of Bereiter? In metaphorical terms, learning and knowledge can be conceived of as a cubic matrix (classification schema) within the context of a human mind. This is an ‘artifact’ within my mind. Hopefully you will absorb it as an artifact in your mind as you read and reflect on the text. This last statement points out that learning involve more than just mental, or cognitive, artifacts “downloaded” into your cranial “container.” Learning is a process as well as a generator of mental artifacts. Learning is essentially a *mind-expanding process*. To understand this learning process, we will have to understand how the human mind works in terms of relating our mental artifacts with our behaviors (activities). Thus, our discussion of learning would not be complete without some discussion of how the mind works (i.e. the most current theory of mind). But before we

proceed in that direction, let me use the cubic matrix conception of learning and knowledge that we just described in this section to provide some kind of meaningful interpretation to the academician's statement presented earlier.

Is "To Learn How To Learn" Meaningful?

Our categorical distinctions of learning (based on categories of knowledge) do not allow for meaningful phrases of the sort 'to learn how to learn.' In terms of our artifact and the logical way of reasoning, that phrase is *tautological* if it refers to a single agent. We can accept the phrase "learning about knowledge" which specifies knowledge as the content of educational theories. But this second phrase, as it stands, is ambiguous. There are different kinds of learning based on different kinds of knowledge involved. Thus for learning to be meaningful, we need to specifically state what kind(s) of knowledge is (are) being alluded to. For example, are we concerned with the knowledge associated with using basic math or are we concerned with the knowledge associated with formulating and solving differential equation models in some scientific domain such as theoretical physics? Why do we need to make this kind of definite specification? Because the first kind of learning is essential for success as construction worker, but the second kind of learning is essential for success as a theoretical physicist. Is our social objective more of the first kind of success or of the second kind? If the weight is placed on the second, then the implications are that we should allocate more academic resources to the second kind of learning relative to the first kind of learning in order to fulfill public expectations.

Do teachers learn? Yes they do. What could they learn? Well, as an example, a high school science instructor could learn more about knowledge generated in the various domains of natural sciences by taking college level courses in these disciplines in order to enhance his level of expertise in natural sciences. Also, this same instructor could learn more about the theories underlying teaching practices in secondary education by taking graduate level courses in education. Furthermore, this same instructor could learn on the job about the formal educational process, which involves instructors teaching and students learning in an academic setting. Thus, while the teacher is doing teaching in the context of the academy, the teacher could also be undertaking self-learning (classroom based research) as well. This in-class learning of how students learn about some subject-matter within the academy, however, must be construed as instructors learning about how students learn about a subject matter (content), and not as students learning about their own learning process which to my way of thinking is tautological. To put it in another way, teachers can learn about "how to teach" (or

about algebra, for that matter), but they cannot learn “how to learn” as the learning process is the learning process, it is a manifestation of thinking.”

Thus, in our “cubic matrix” perspective of thinking, instructors could conceivably teach and learn simultaneously in their own classrooms. However, they would necessarily have to teach and to learn *different kinds of knowledge*. I should also point out that high school students could also simultaneously teach as well as learn within the context of the formal educational structure. This becomes quite obvious when we make note of the use of in-class student tutors. The complexity of a subject matter enables us to establish a measure of expertise regarding knowledge about this complex subject matter. While the instructor has a higher level of expertise than all the students do (by virtue of taking college level courses on the subject matter), as the students learn in response to the instructor’s teaching, some students may begin to develop a higher level of expertise relative to other students in the class. This gap in the levels of student expertise can be utilized in the form of student tutoring (teaching) in an attempt to achieve homogeneity in student learning.

So we are now at the level of complexity where we can now meaningfully say that in the formal educational structure, instructors teach and learn and students learn and teach. And this depiction of the academy is not as simplistic as when we first described its activities in terms of sociological roles in the earlier section on Loose Framework of Analysis. Note also that we have broken out of a mental “box” mindset, i.e., the “either/or” kind of reasoning. All individuals in the academy can teach *and* learn and not necessarily teach *or* learn. This “deeper” perspective of what goes on in the academy is attributable to the treatment of learning and knowledge building as a *complementary* cognitive concept rather than an *autonomous* cognitive concept.

Alternative Theories of Knowledge and Ambiguity

In the two prior sections we presented a conceptual and theoretical perspective that inferred learning was related to knowledge and that all forms (the scope and depth schema) of knowledge were artifacts of the human mind. However, we did not deal with the question: How does the human mind work in terms of knowledge building and relating knowledge (internal cognitive entities) with human behavior (external)? Before we do so, let us probe the most complex aspects of knowledge itself. That is to say, let us try to examine the very foundations of the knowledge that is taught and learned in the academy. It is in regards to this very deep aspect of the content that we must allow for alternative theories of knowledge and where we will en-

counter the concept of ambiguity. But we may have opened ourselves up to an insurmountable task. This is because the object of our inquiry (knowledge in the context of mind) has such an extremely wide scope (about all kinds of human activities) as well as an exceedingly deep level of complexity associated with it. The philosopher of science, William Bartley III (1990), has used the metaphor of the ocean's depth, "unfathomed knowledge," in the title of one of his books.

Therefore we are (or at least the author is) faced with the dilemma as to how to go about discussing the subject of knowledge: local setting or global setting? Well, I have decided that we will neither resort to local setting or to global setting but to *both*. And we will proceed in an eclectic fashion in terms of modes of inquiry. Note that intellectual laziness does not motivate this decision. Rather, intellectual honesty does so. Under the circumstances, maintaining only an *analytical* mode of inquiry is just not warranted (too restrictive) relative to the scope and depth of our object of inquiry in this section. We need to be open or receptive to any and all modes of inquiry; i.e. we need to adopt what the physicist Basarab Nicolescu (2001) calls a "transdisciplinary" mode of inquiry. Furthermore, we have left learning as a middle-level concept in terms of complexity but the concept of ambiguity will be examined as a very deep level concept. Thus, to establish any kind of meaningful relationship between the two concepts you must be able to transcend the gap or space between the two levels of complexity. It is my hope that the readers of this paper can bridge the complexity gap by being willing to go beyond the edge of their current theories of knowledge.

To use a metaphor that should be understandable to most elementary and secondary school educators: Who "certifies" the knowledge that is taught in the academy? Of course there is no formal certification process comparable to teacher (competency) certification programs. But there is an informal process based on the concept of authority. Then who are the authorities and by what criteria are they deemed to be in a position of authority? Without getting involved in any extended discussion, it used to be that philosophers and religious leaders were deemed to be the people in the position of authority because philosophers were the seekers of Truth and religious leaders were the receivers and gatekeepers of some kind of Divine Truth. The tug-of-war between religion and philosophy manifested itself in education in terms of the distinction between parochial and public schools. Lately, scientists have tended to displace philosophers and religious leaders as people in the position of authority by virtue of the "power" of their scientific knowledge (Sir Francis Bacon, 1620/1878) rather than the Truth status of their knowledge. Underlying all of the historical changes in terms of authority has been a tension among alternative theories of knowledge in the global setting. And this

social competition among concepts, theories, doctrines and ways of knowing (modes of thought) relating to knowledge and the human mind has had an external impact on the (academic) theories of education, which are for the most part formulated in terms of a local setting.

While the history of intellectual thought on knowledge is extensive, we can “cut to the chase” by focusing our attention on the Truth status of knowledge. There are two extreme conceptual perspectives on the Truth status of our knowledge. We can have knowledge about some things in our lives that is absolutely certain, but this kind of knowledge is not created by the human mind (consciousness). Rather, it is the kind of knowledge that is received by the human mind via divine intervention. In other words, we can have some forms of *absolutely certain* knowledge, but it is by the “grace of God” (i.e. some Supreme Being) and not by any of mankind’s doing. Any knowledge derived by human modes of inquiry (such as reasoning) is necessarily ambiguous. To return to the certification of knowledge metaphor that was introduced earlier in this section, the only authority of Truth is God. The other extreme perspective is there is no God (or “God is dead”) and that all of mankind’s knowledge has been and will forever be created by the human mind, i.e. consciousness. Consequently, all knowledge is necessarily ambiguous (uncertain) and Truth is an illusion.

Of course, these polar conceptions of Truth represent the boundaries of the path down which mankind’s intellectual development has been traveling. During the era referred to as the Enlightenment, Western philosophical thought emphasized the development of the concept of Universal Ideas. These universals were principles that could be derived and comprehended by human minds via formal analytical thought. The concept of Universal Ideas did not appear to be inconsistent with the concept of Divine Truth. However, there was no way that humans could establish the one-to-one correspondence between Universal Ideas and Divine Truth. Nevertheless, the Enlightenment Era created an intellectual environment (modernity) which fostered advances in the creation of other forms of human knowledge (derivatives of Universal Ideas). But at the same time individuals who wanted to believe that there was some unknowable God whose Divine Truth apparently supported mankind’s quest for Universal Ideas were accommodated. Thus, there was no need for a recurrence of the dreaded Inquisitions of the Middle Ages. For a hierarchy of Truth status was created (Divine knowledge, universal knowledge, and derivative knowledge) that accommodated the existence of knowledge seeking mankind and the belief in the existence of a God. Unfortunately, the intellectual environment is now radically changing. The concept of Universal Ideas is being intellectually discredited and the polar position that only the human mind creates knowledge is gaining

social acceptance. Within the new intellectual environment that is evolving, for want of a better term let's call it postmodernism, *ambiguity* is the "preeminent characteristic" (Brown, 1995, p. 2) and there is a growing quest for new forms of social unity in the face of increasing multiplicity (relativism).

How Does the Mind Work?

Let us now return to the discussion of the process aspect of learning. I mentioned earlier that knowledge building results in cognitive, or mental, artifacts but that learning was more than just the product; it was also *the process of creating cognitive artifacts*. The product and process conceptualization of learning, as associated with knowledge building, can be formulated in terms of a problem-solving exercise. The human mind is set upon the task of identifying, defining and solving a new problem. Note that I said a new problem. Going back to "setting out garbage," the reason I did not initially consider that particular activity as either a problem-solving or knowledge building kind of activity was because for me it was based on knowledge already learnt, i.e. a problem already solved. However, we must remember that knowledge is a stock variable as well as a flow variable. Once we have learnt something anew (flow), it becomes part of our mind, or consciousness (stock)². In other words, learning is a *mind-expanding kind of process*. And thereafter, much of our daily routine activities is based on stored knowledge and does not involve problem-solving activities where we are learning new knowledge. Nevertheless, both categories of activities involve the operation of our minds. Consciousness is an all-encompassing property of human existence, although it may often seem like we are doing something unconsciously or subconsciously.

What I have said in the previous paragraph represents nothing novel as far as the history of educational philosophy is concerned. The pragmatist and educational theorist John Dewey (1899, 1910, and 1933) has already expressed the distinction between process and product and also between unconscious and conscious behavior. Focusing on the human thought process, or "thinking." However, Dewey's comprehension of how the human mind worked was very limited relative to what we know today via contributions from such recently created disciplines as cognitive science and neuroscience and from changing scientific paradigms in other disciplines, such as physics, biology and psychology, as well. To keep the focus of this

² For additional insights on the stock nature of knowledge, refer to the investment perspective on creativity in Sternberg and Lubart (1995) and also the discussion on epistemology and economics in Bartley III (1990).

paper narrowly on education, let us concentrate on the question of: What is thinking? In effect, we will be entering a third order exploration of cognition utilizing some of the insights (knowledge) gained recently in these other disciplines.

We have already undertaken what the philosopher John Searle (1983, p. 156) calls a “second order” investigation of the question: What is thinking? Thinking occurs when the mind creates and utilizes knowledge and where learning is involved. Thus, instead of speaking about thinking *per se*, we were earlier discussing a cubic matrix schema of knowledge and relating it to learning and we were also making a distinction between artifact and cognitive process. These earlier endeavors all fall under the rubric of “thinking” in Dewey’s sense. Thinking is a cognitive activity, i.e. part of our consciousness. However, we generally think along very narrow or restricted modes of cognitive process (mindset). Thinking is usually associated with analytical modes of thought; i.e. the mind operates along the lines of logical reasoning and classification, or in terms of a *reductivist* strategy of knowledge building. However, thinking need not be only associated with rational modes of thought. A cognitive revolution is taking place that is leading to a third order understanding of thinking. Our consciousness is equally capable of holistic modes of thought such as artistic creation (Langer, 1988) and/or dialogic reasoning (Wells, 1999), or in terms of a *constructivist* strategy of knowledge building. And it is the mind’s holistic capacity that appears to enable Western thinkers to resolve many seemingly intractable paradoxes lately.

There have been significant paradoxes in philosophy, theology, mathematics and the sciences. Generally, the resolution of a paradox (problem solving) culminates in a significant advance in human knowledge along a broad front (different domains of knowledge). A long-standing paradox regarding the human brain and the human mind appears to be on the verge of such a resolution. And this is sending shock waves to all the fields of human knowledge (i.e. the subject matter taught in schools). For the past two centuries or so, scientists have adopted a reductivist strategy of knowledge building and utilized a deductive reasoning mode of thinking as their bases of determining scientific causation. Furthermore, the underlying logic of deductive reasoning went all the way back to the Greek philosopher Aristotle. The reductive, Aristotelian way of thinking (mindset) fostered a subject-predicate mode of mental inquiry, i.e. the mind inquires about the brain and also an either/or (duality) pattern of reasoning. With the advent of scientific medicine, the brain could be analyzed along with the body’s other various components. But the totality of human body components could not explain the soul nor could classification of the parts of the brain explain the mind.

This allowed for the separation of religion and philosophy from the sciences. The mind was a metaphysical phenomenon and therefore should be subject to philosophical inquiry and along similar reasoning; the soul belonged to the purview of theology.

How is the mind-brain paradox being resolved? Interestingly the impulses for change are coming neither so much from medicine (brain) nor philosophy (mind) but from new technological developments (computer science) and new scientific paradigms in physics and psychology and metaphors from biology and zoology. And much of this interdisciplinary thrust regarding our understanding of the human mind is manifested in the new field of cognitive science. Science has gained the dominance in our quest to understand how the mind works. And in so doing, science is becoming the higher authority that certifies the relevant knowledge that, socially speaking, “ought to be taught” in the academy. What are the essential features of the scientific paradigm of mind? How do we think? The new scientific paradigm relaxes the restrictions that Aristotelian (bivalent) logic places on modes of thought, accepts the concept of “emergent” phenomenon, and relies a great deal on the evolutionary process and biological metaphors to explain the essence of the human mind which is consciousness.

The evolving scientific paradigm of mind places more emphasis on constructivist strategies of knowledge building rather than reductivist strategies. The bias of bivalent logic was that it fostered a mode of thinking that focused on the *being* rather than the *becoming*, by virtue of not allowing the excluded middle. The logical purist would say that this leads to *contradictions* or *impossibilities*. Maybe so, but it also hinders consideration of *possibilities*. Consider the analogy of the opposites (duality): black *or* white. White is not black and black is not white. If we also allow for black *and* white, (the excluded middle) it appears that we have a contradiction, or at least an ambiguity. However, out of this possibility emerges shades of gray. We now have an entire *spectrum of alternatives* ranging from black at one end to white at the other end. In a similar fashion, the mind is now being conceived of as what the neuro-psychologist and 1981 Nobel Prize winner in medicine, Roger Sperry (1995) called an “irreducible emergent phenomenon” that complements the brain. And from the deepest ambiguities (possibilities) of our minds (i.e. consciousness) emerge reality (meaningful ideas) or at least our knowledge of reality. Therefore the prevailing epistemology is that we construct our social identities and our knowledge of nature via our individual and collective consciousness. Anthony Giddens (1990), a sociologist at the London School of Economics, had referred to this as “reflexive modernisation.” Our consciousness is part of some evolutionary process that determines the biological and social growth of the human species and

possibly the development of the universe (nature) in terms of what physicist John Wheeler (1981) has provocatively called the “participatory anthropic principle.”

Conclusion

Since the primary purpose of this paper is to stimulate professional reflection on the meaning of learning, I will not offer any specific conclusion(s) to an ongoing process. In closing though, I would like to say a few words regarding the apparent *attitude* that many educators have regarding the concept of ambiguity (uncertainty) and *what attitude I believe they ought to have*. To do so I will quote a social scientist and a secular humanist. Instead of having a *positive* attitude towards ambiguity, many educators appear to have a *negative* attitude, or even an *aversion*, with regards to ambiguity. This is evidenced by the propensity to use the phrase “tolerance for ambiguity” or to disambiguate all their pronouncements in the classroom. The hypothesis of this paper is that ambiguity is an essential property of all human knowledge and as educators who teach mankind’s knowledge to students; we should “embrace” ambiguity rather than just “tolerate” it. Embracing ambiguity means being more open to alternative ideas, never being very narrow in our thinking as we practice the art of teaching (even though we may be scientists as well as teachers). Kenneth Arrow, 1972 winner of the Nobel Memorial Prize in economics, has this to say on this matter:

The sense of uncertainty is active; it actively recognizes the possibility of alternative views and seeks them out. I consider it essential to honesty to look for the best arguments against a position that one is holding. Commitments should always have a tentative quality. As may be supposed, I have always enjoyed satire and irony, as well as logical paradox; Swift and Russell are favorite authors. (1992, p. 47)

Kenneth Arrow’s words are echoed by those of humanist Robert Grudin, a professor of English at the University of Oregon, who in an essay on dialogue states (1996, p. 211): “Unless they are understood in a context that includes irony, ambiguity and contingency, conclusions are always wrong and assertions always mistaken”. Unfortunately, a majority of educators are not like Arrow and Grudin. Their attitude towards ambiguity is quite negative, if not outright hostile. And this is reflected in their teaching practices and students in turn do not learn course content in an appropriate or meaningful manner.

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