


Peirce and Educational Philosophy



Phyllis Chiasson

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Abstract:

Embedded within Peirce's complete body of work is a "design for thinking" that provides a sturdy foundation for the development of three important learning capabilities. These capabilities are 1) the ability to identify, compare, and contrast qualities, 2) the ability to perform analyses, and 3) the ability to appropriately interpret the meaning of signs. Once teachers learn to develop their own intellectual potential by expanding these capabilities within themselves, they will be able to begin bringing about the development of these capabilities in their students. These three fundamental learning capabilities (qualification, analysis, and interpretation), once identified, developed, and applied to the mastery of educational skills and subject matter form the foundation of a common-sense approach to educational reform. Peirce asserts that "right reasonings" must be informed by ethical considerations, which in turn have been informed by the highest of aesthetic impulses. From this, we can extrapolate the importance that an educational model based upon Peirce's philosophy must place upon *aesthetic* and *ethical* considerations, as well as logical ones. Once fully understood, the philosophy of education embedded within Peirce's epistemology can revolutionize American educational practices.

Keywords: Education, Curiosity, Critical thinking, Vagueness, Inference, Basic skills

Introduction

Although Peirce is generally acknowledged as the founder of the American philosophical movement known as pragmatism, few have recognized the significance of Peirce's form of pragmatism as an educational philosophy capable of providing a basis for the development of sound educational practices. In his 1868 essay "On a New List of Categories," Peirce established an ontological set of categories (firstness, secondness, and thirdness) as the keystone of his philosophical system. Nearly everything else that Peirce wrote after this early piece was founded upon this set of categories. Peirce believed that this "new list" would stand as his greatest achievement and argued for this set of universal categories by showing that they are necessary for bringing together all of the elements of experience. As such, these three categories also comprise the keystone of his embedded philosophy of education. Peirce's "new list of categories" and the philosophy of reasoning he built upon these are fundamental to the development of sound educational practices.

Arguably, each of the assumptions listed below, could merit a discussion of this length

all on its own. However, because of length constraints, we will begin with four basic assumptions. Three of these are basic to teaching; one is specific to aspects of Peirce's pragmatism.

1. Educators already have access to knowledge concerning the appropriate subject matter that their students need to master.
2. The short-term effectiveness of any educator is reflected by the degree to which his or her students demonstrate, at the completion of a course of study, mastery of the skills and subject matter which that teacher has taught.
3. The long-term effectiveness of a teacher, and of any educational program in general, should be measured in terms of the degree to which students are able to continue to develop as learners once they have left a particular teacher's class or a particular educational program.
4. Those educators who master the skills for deliberately applying Peirce's three categories can measurably enhance both their short-term and long-term effectiveness as educators.

Our proposition here is that, in addition to developing subject-matter expertise, the core purpose of teacher education should be twofold. First, educators should be required to learn and demonstrate mastery of the fundamental set of skills for effective reasoning: qualification, analysis, and interpretation. These three sets of skills are reflective of the capabilities necessary for deliberately maneuvering within each of Peirce's three categories. Secondly, educators should learn (and demonstrate mastery of) the pedagogical skills for assisting students to develop these same capabilities.

Peirce and Educational Theory

Peirce's "new list of categories" is founded upon the premise that there are in nature ultimate ideal forms of actual and conceptual things (including truth and beauty) and that the properties (qualities) of these forms are real, whether or not anyone ever comes to recognize them as such. He conceived the role of inquiry as the unfolding the properties of these forms toward eventually discovering that which is *ultimately ideal*. Because we humans are fallible beings, however, Peirce qualified his "ultimate idealism" (Peirce, 1955a, pp. 266-67) with the assertion that we can never know for sure that we have achieved that ideal reality. In other words, good inquirers will remain alert and open to examining even their most cherished "truths," should new facts call these into question. According to Peirce, good teaching depends upon the degree to which educators recognize and embrace their own fallibility. Good teachers must, themselves, be learners imbued with the "will to learn." For Peirce, the effectiveness of an educator

should be measured by degree to which that educator possesses intellectual curiosity and can excite this curiosity in students, while at the same time providing them with the means and opportunity to learn more effectively. Peirce spoke about this "will to learn" and his corresponding disdain for the pedantic methods of American college educators in his time during his lecture on "The First Rule of Logic," which he delivered in Cambridge in 1887 (Peirce, 1992).

For Peirce, the "will to learn" is inexorably tied into the capability for exercising "genuine doubt." He contended that teachers must refrain from thinking that they "know it all" and, instead, operate from the sense they are "miserably ignorant," if they are to spur themselves and their students on in the "toilsome path of learning." In other words, teachers who wish to inspire learning on the part of their students must, themselves, possess the capability for engaging in genuine doubt.

Peirce's concept of "genuine doubt" stands in contrast to Cartesian pseudo-doubt (for which Peirce had great disdain) as well as to phenomenological claims that all knowledge is an affair of the senses (Peirce, 1955a, p. 256). It is impossible, Peirce points out, to begin an inquiry by doubting everything. To pretend that we are doing so is foolishness. To say that we can begin an inquiry by observing the "first impressions of sense" is also nonsense, since we are all "laden with an immense amount of cognition already formed," from which we cannot escape, even if we wanted to. If we should be able to rid ourselves of what we already know, Peirce points out, we would most likely end up "making all knowledge impossible" to ourselves. Thus, the place from which we must "set out" is from exactly wherever it is we are when we do set out. Each of us is, at every moment, stepping into the future with whatever old baggage we are carrying with us, and with whatever skills we already have for transforming that baggage into new knowledge. Education, in the sense of Peirce's pragmatism, should be true to its Latin roots¹, leading each of us from wherever it is we are toward what we do not yet know-and, most importantly, to being open to encounter what *we do not yet know that we don't know*.

Anything that we discover from encountering what *we do not yet know that we don't know* relies upon our ability to recognize anomalies ("surprising facts") and their significance (Chiasson, 2000). Such is the beginning point of any new learning-from the first-grader "discovering" a connection between words on a page and the ideas these words convey, to the graduate student "discovering" that the meanings of the facts and knowledge already acquired must continue to evolve within contexts. Teacher/learners of Peirce's sort (a sort whom he also referred to as a "Critical Common-sensists") must

have "a high esteem for doubt," combined with due respect for the necessity and power of belief. Peirce wrote:

Belief is not a momentary mode of consciousness; it is a habit of mind essentially enduring for some time, and mostly (at least) unconscious; and like other habits, it is (until it meets with some surprise that begins its dissolution) perfectly self-satisfied. Doubt is of an altogether contrary genus. It is not a habit, but the privation of a habit. Now a privation of a habit, in order to be anything at all, must be a condition of erratic activity that in some way must get superseded by a habit. (Peirce, 1955a, p. 257)

Although for each of us, our *existing* knowledge and *mastered* skills have come from the building up of mental and physical *habits*, all *new* learning must come out of an encounter with *doubt*. For, before we can learn anything new, we must first become "open to doubt." In other words, we must have the ability to recognize the inherent fallibility of human minds (including our own), and be able to recognize anomalies ("surprising facts") which do not square with our existing beliefs—allowing these to bring us to a state of "genuine doubt." Those who habitually dismiss anomalies (or completely fail to notice them due to ignorance of a particular subject) cannot learn anything new; they can only "collect" more facts and information about whatever it is they already believe to be true and ignore those which do not agree with their beliefs. For, anyone who truly believes that he or she already knows the truth of something will have no room within such a belief (until meeting with "some surprise that begins its dissolution") to question the truth of that existing belief.

One problem with beliefs in general is that, for each of us, our most tenaciously held fundamental beliefs about what is absolutely "true" have been "acritically" derived—which is to say that, because they seem "patently evident," these beliefs have never been called into question. For example, we still have in our language the words "sunrise" and "sunset." These words come from their original usage within an era for which it was "patently evident" that the sun "rises" in the morning and "sets" in the afternoon. The obvious "rising" and "setting" of the sun would have been so "patently evident" to pre-scientific minds, that the idea of even thinking to question such a belief would not have come up. According to Peirce, our degree of understanding of any such "acritically" derived belief will be "invariably vague," because the "indubitable" (undoubted) vagueness of "acritically derived" beliefs dictate that vagueness will remain, until we have reason to question our belief (Peirce, 1955b, p. 297).

"Vagueness," Peirce warns us, "which is no more to be done away with in the world of logic, than friction in mechanics," can have the effect of completely obliterating doubt

(Peirce, 1955b, p. 297). (Perhaps this explains the coercive power of opinions born of ignorance—the all too frequent tendency of some people to be most certain of the absolute truth of matters about which they are essentially ignorant.) Peirce deemed it important that the “Critical Common-sensist” (which corresponds to the concept of a “teacher/learner”) recognize the relationship of the vagueness of “acritically derived” beliefs and the fundamental ignorance that accompanies the absolute certainty born of such beliefs.

This paradox of the “vagueness” of acritically derived beliefs and the corresponding absolute certainty that accompanies such vagueness presents a difficult problem for developing teacher/learners who can, in turn, develop the will-to-learn in their students. The phenomenon of the power of “vagueness” to completely obliterate doubt presents the fundamental roadblock to educational change. Because our institutions of higher learning do not set out to deliberately develop teacher/learners capable of (and willing to engage in) critical thought, we continue to perpetuate an “acritically derived” educational system. This perpetuation feeds upon itself, for the more “watered-down” curricula and standards have become, the less possible it is to bring about educational reform (Ravitch, 2000). Today’s teachers are, for the most part, themselves products of inferior educational curricula and standards. It well may be that, without mandated foundational reforms in both curriculum and educational standards, teachers and their students will continue to pass on the “invariable vagueness” of their acritically derived beliefs, thus perpetuating intellectual ignorance throughout our public school systems. This is why Peirce contended that educators should operate from the sense they are “miserably ignorant,” if they are to spur themselves and their students on in the “toilsome path of learning.” That is why teachers who wish to inspire learning on the part of their students must, themselves, possess the capability for intellectual curiosity—for engaging in genuine doubt.

So it is that, according to Peirce, only when teachers, themselves, possess the “willingness to doubt” (or intellectual curiosity) can they inspire the “will to learn” in their students. This contention still stands in opposition to much of what goes by the name of teaching and learning in public education these days. So called “traditional” teaching methods, which maintain a focus upon collecting data and information and regurgitating these upon demand, bypass the issue of intellectual curiosity and inquiry altogether. On the other hand, so called “modern” methods, have resulted in “watered-down” curriculums and standards that have been lowered so far that little actual learning is taking place (Ravitch, 2000). Neither “traditional” nor “modern” teaching

systems are providing students with the skills, practice, and expectations necessary for developing facility with reasoning skills—the tools of inquiry. If required at all, reasoning is not a skill that students are expected to have until the higher grades. By the time reasoning is an expected skill, it is considered to be a function of innate intelligence, not a skill to be deliberately taught and mastered.

Although a few teachers and students arrive at the classroom with a fully developed sense of curiosity, most do not. Even intellectually curious educators may lack knowledge of the pedagogical methods needed for awakening this sense in their students. Since Peirce's embedded educational theory requires that both students and educators be learners with a strong sense of the "will to learn," the first step in bringing about an educated citizenry based upon Peirce's pragmatism is to do what we can to develop intellectual curiosity on the parts of teachers. Those teachers can then begin to develop methods of inciting this curiosity in their students.

If contemporary educators were to adopt Peirce's contention that good teaching is a matter of inciting the "will to learn" among students and providing them with the tools for good reasoning, the issue of traditional versus modern educational programs would become moot. Teacher training would focus upon helping educators develop and apply effective pedagogical methods to awaken the "will to learn" in their students and would assist educators in learning and mastering these same reasoning skills. Thus, we must first help teachers gain and sustain the capability for curiosity (or "genuine doubt") if we are to begin to bring about effective changes in the educational system. Curiosity is a consequence of being awake to anomalies—to those often-subtle differences that call beliefs into question. The skills needed for developing curiosity in teachers and students (the ability to effectively qualify, analyze, and interpret the elements of experience) are the same skills that underlie the ability to make reasoned judgements. Thus, Peirce's brand of curiosity and his concept of good reasoning are both made up of the same basic skills that are necessary for learning to make effective inferences.

Inferences

In the most general of terms, inferences are mental connections between something that we already believe is true and something that we believe is connected to it in some way. Peirce's unique concept of inference is a logical construct founded upon his "new list of categories." He contended that, in addition to the commonly accepted logical forms of deductive inference (the purpose of which is to explicate and demonstrate) and inductive inference (the purpose of which is to generalize and amplify), there is a third

logical form: abductive inference. The purpose of an abductive inference is to develop hunches and generate new ideas.

According to Peirce, each of the three inference methods has a role to play at a different stage of the reasoning process. Abductive inferences belong to the hypothesizing stage of reasoning, providing new insights, ideas, and hunches that can lead to the creation of original ideas and/or the discovery of hypotheses worthy of testing. Deductive inferences are tools of the analytical stage, used for describing a proposal or hypothesis and structuring methods for demonstrating it. Inductive inferences verify, amplify, and generalize. They are meant to work together with deductive inferences and serve the purpose of evaluation. All purposeful thought relies upon the making of one kind of an inference or another—regardless of whether the subject of that thought concerns the number of pink and blue bunny rabbits in a picture, what to buy at the grocery store, or the projected trajectory of a space vehicle.

The ability to make good inferences at appropriate stages during an inquiry is synonymous with the ability to reason well. Peirce described these stages and their applications in his “methodeutic”—which is the operational logic of scientific method (Peirce, 1955c). The ability to reason well depends upon the level of ability an individual has for qualifying, analyzing, and interpreting an experience. In other words, reasoning ability depends upon an individual’s facility with the activities of Peirce’s “new list of categories,” just as does the “will to learn.” Thus, the basic skills required for curiosity and for accompanying good reasoning ability are comprised of one part noticing (qualification), one part analyzing (relating), and one part interpreting (representation). In other words, when learners are masters of the basic skills for good reasoning, they also have the “raw materials” from which to develop curiosity.

Curiosity and Peirce’s Categories

To develop the “noticing part” of curiosity and the corresponding qualification stage of good reasoning requires the ability to identify the qualities of “firstness.” Development of the “analysis part” of curiosity provides the analytical tools for engaging in the actions of “secondness” (or relating). Effective development of the “interpreting part” of curiosity requires facility with Peirce’s category of “thirdnesses,” for making inferences, interpretations, and representations of ideas. Interpretation is the discovery of meaning by analyzing things and ideas (signs) based upon their qualities. We will next deal with each of these categories in detail but. However, before we go any further, let us review the connection of Peirce’s pragmatism to educational theory:

1. Curiosity is essential for learning to take place.
2. At least some degree of facility with engaging the skills of Peirce's three categories is necessary for the development of curiosity.
3. At the root of curiosity is the capability for recognizing one's fallibility, thus enabling the occurrence of "genuine doubt" when facts or circumstances warrant.
4. Curiosity (the "will to learn" brought about by the capability for engaging "genuine doubt") can be developed by increasing a person's abilities for applying skills for engaging Peirce's categories of firstness (quality), secondness (relating), and thirdness (representation) for the apprehension, analysis, and interpretation of experience.
5. For curiosity to be incited and sustained, it must be supported by the basic skills of good reasoning.
6. The ability to reason well depends upon the ability to make good inferences. The underlying skills of good reasoning are qualification, analysis, and interpretation-requiring facility with the activities needed for applying Peirce's "new list of categories."
7. Therefore, the greater one's facility with Peirce's three categories (Quality, Relation, and Representation) the more effective will be the learning that can take place.

Thus, Peirce's general philosophy of education begins with the need to awaken the "will to learn" in both teachers and students. Those who are not naturally curious can be provided with training in the basic mental skills necessary for engaging curiosity. These basic mental skills (qualification, analysis, and interpretation) are synonymous with the basic skills that underlie the ability to make effective inferences (to reason well)-making these skills also necessary for engaging in any sort of intelligent inquiry. Reading, math, science, writing, geography, art, public speaking, dance, auto mechanics and physical education-all require the ability to make effective inferences. For Peirce, all three divisions of logic deal with aspects of inference (Peirce, 1955c). The capability for making good inferences underlies the capability for "right reasoning"-for making reasoned judgements about what is (and is not) beautiful, ethical, and true (Peirce, 1955c). The degree of facility that a person has for making inferences and reasoned judgments depends upon that person's ability to perform the skills within each of Peirce's three categories.

Of course, you will never find a statement to this effect in all of Peirce's prodigious writings. Nor will you find there any mention of a *method* for awakening the "will to learn" in teachers or students. As mentioned before, Peirce's educational philosophy is embedded within his general theory of pragmatism. Peirce seems to have made an

incorrect assumption that having the “will to learn” is a matter of personal choice, and that anyone of reasonable intelligence who so desires can choose to engage this will upon demand. Peirce apparently did not recognize that the capabilities for engaging and sustaining curiosity do not already exist in everyone capable of intelligent thought. His theory of pragmaticism, however, shows us quite distinctly what those capabilities consist in, providing both the roadmap and the vehicle for arriving at significant improvement in American educational practices.

Again, if we want to improve education, our first task must be to awaken curiosity among teachers and provide them with the tools for improving their own reasoning abilities. Teachers who, themselves, master the basic skills for making good inferences can be taught the pedagogical skills for helping students to master these skills as well.

The Basics

The basics of Peirce’s pragmaticism are the underlying abilities to effectively qualify, analyze, and interpret experience. This word “experience” can refer to individual experience as well as to the curricular experience of any subject matter content—from learning to read, to studying Shakespearean plays, to rebuilding an engine, to learning about safe-sex practices. People, who are intelligent in the sense of being “experience-based” learners or “experimentalists,” as opposed to mere “book learners” or “fact collectors,” already possess some degree of facility with the activities of qualifying, analyzing, and interpreting. Yet, even they will benefit from practice with the basic skills for effectively engaging Peirce’s categories

Qualification, the skill for working within Peirce’s first category², is honed by developing the ability to recognize similarities and differences among things based upon their qualities. Facility with the qualification stage is vital to waking up the “will to learn.” As they learn to notice qualities, students can begin to identify anomalies, the first stage in awakening curiosity.

Analysis is the primary tool for engaging skillfully in the activity of Peirce’s second category, which Peirce also termed as “action” and “relation.” The category of secondness is comprised of the activities of bringing qualities into relations with one another. Like qualification, analysis includes a set of teachable skills. Analysis relies upon applying qualitative similarities and differences within a set of forms and systems for sorting, classifying, planning, preparing, and predicting what will happen next. It provides a way of relating the qualities of thoughts, feelings, and sensations and of working ideas out (or figuring them out) before acting based upon them.

Interpretation, Peirce's category of thirdness, which he also termed "representation," "mediation," and "thought," relies upon the skills of qualification and analysis. Effective interpretation requires skill for deriving and communicating meaning based upon signs. Peirce's theory of signs and their meanings (based upon the keystone of his three categories) has now grown into the field of study that is variously called semantics, linguistics, and semiotics. Peirce's sign theory is a theory of communication and interpretation having to do with the meaning of signs within contexts and matrices (the continua "within which all things swim"). Although Peirce's theory of interpretation is recognized as an essential element in certain fields, such as computer programming and comparative literary analysis, it is unknown within most educational specialties. This is unfortunate since Peirce's theory of interpretation by means of signs is simple enough to be adapted and used for helping even young children to develop better reading, writing, and reasoning skills—and enhanced creative and analytical abilities as well. Now, let us make a closer examination of each of these categories and the skills required for effective performance of each.

The Skills for Engaging Peirce's Categories

1) QUALIFICATION

An educational model built out of Peirce's pragmatism must begin by helping students to develop the skills of qualification. Qualification is the skill of identifying and discerning among qualities. The concept of quality is an important aspect of Peirce's pragmatism. For Peirce, the qualities of things are what make them real. All reasoning begins with the capability for making distinctions among the qualities of things (including ideas). Qualities are properties of things—meaning that they are characteristics sufficient for identifying a subject. According to Peirce, qualities can be sorted into one of three "modes of being": 1) feeling, 2) sensation, 3) reason. You may notice that these three modes of being seem to have a correspondence to Peirce's three categories. If so, you are right on the mark. Feeling is the mode of consciousness corresponding to the category of quality (or firstness). We experience the category of secondness (the relating of actions and interactions of the world of brute actuality and facts) by means of our senses. We think (or reason) about what we feel and experience from within the category of thirdness, which includes relationships, thoughts, and representations (all of which are had by means of signs). Concerning modes of being Peirce wrote:

One is struck with the inexactitude of thought even of analysts of power, when they touch upon modes of being. One will meet, for example, the virtual assumption that what is relative to thought cannot be real. But why not exactly? Red is relative to sight, but the fact that this or that is in relation to vision that we call being red is not itself relative to sight; it is a real fact (Peirce, 1955a p. 177).

For Peirce, reality is a function, not just of actual things and events, but also of the properties of ideas. According to Peirce, a thing or idea is real if it possesses sufficient properties (or qualities) to identify it—regardless of whether anyone ever knows about these properties. For example, the properties of gravity and of the movement by which the earth circles the sun would still be true, even if mankind had never figured these out. Rational thought is a process of identifying, analyzing, and interpreting (making inferences about) relations among the qualities of signs.

Each of the three “modes of being” (feeling, sensation, and reason) contains certain sorts of qualities. Qualities of feeling (which include opinions and attitudes) have to do with aspects of affect such as joy, sadness, beauty, injustice, curiosity, value, intention, purpose, desire, awe, and anger. Qualities of sensation include qualities of perception, such as vision, smell, sound, texture, taste, and balance. Sensory qualities include any that can be perceived and verified by means of the senses or by extensions of the senses, such as telescopes, microscopes, oscilloscopes, etc. Qualities of reason include qualities of form, quantity, shape, substance, size, and transformation—and any other qualities that indicate comparison, contrast, or objective determinations that are made according norms and standards.

Qualification training focuses upon developing the capability to determine qualitative similarities and differences among things and ideas. The ability to identify multiple layers of similarities and differences is crucial for the development of all types of reasoning—including creative reasoning (the ability to recognize and create metaphorical and analogous relationships.) *Differences* help in identifying the uniqueness of individual things. *Similarities* help in developing analogous relationships and in identifying general (or categorical) relationships. Different reasoning methods require different ways of noticing qualitative similarities and differences among things. *Abductive* reasoning requires the ability to identify differences in the form of anomalies (often unique and unusual differences) among things and the ability to identify analogous (or metaphorical) similarities. *Deductive* reasoning, which is made up of two stages: explication and demonstration) relies upon the ability to identify qualitative differences to set up the categories for the first stage. Deduction relies upon the ability

to identify qualitative similarities for demonstrating (as say, by means of model, prototype, performance, exhibit, display, or enacting a formula) of the previously explicated components. *Inductive* reasoning relies upon identification and classification based upon qualitative similarities to sort things into appropriate categories.

QUALIFICATION: A SUMMARY

Awakening the will to learn means awakening curiosity. The first stage of curiosity is noticing. The degree of noticing that leads to curiosity requires the ability to identify subtle differences and similarities among the qualities of things. Different reasoning methods require different ways of noticing qualitative similarities and differences among things. Skill for identifying qualitative similarities and differences is fundamental to the development of standard and creative reasoning abilities.

2) ANALYSIS

The skills of analysis must be mastered in order to gain facility with making good inferences. First, we notice and explore unique qualitative similarities and differences. Then we use qualities to organize these similarities and differences by means of an analysis as we begin our interpretation of a sign or context. Analysis skills are a set of formal relational methods for creating, unfolding, or exploring relationships between things and qualities. Like blueprints and maps, analysis skills allow us to think things through to figure out in advance what we want to do and how we want to do it.

Peirce's pragmatism places the meaning of a word, thing, or event in the future. Analysis is a tool for organizing qualities toward the eventual (or future) determination of meaning. We can only know what a word or concept means, Peirce asserted, based on its effect upon the conduct of human behavior. Analysis is the tool by which we can determine, in advance, the probable effects of doing (or not doing) something. By means of analysis we can relate what has already occurred, to what is occurring in the present, and make propositions concerning the probable effects of future conduct. The ability to analyze is crucial to making good decisions and for communicating ideas to others. Analysis is the key to the formulation of worthy goals; to choosing between goals; to good planning and preparation for reaching goals; and for figuring out problems along the way. Analysis is the tool for identifying and bringing about what we desire to have in the future. It is the means for changing the only thing that we can change—our own future behavior. Peirce repeatedly emphasized the future aspect of his pragmatism. The future, or rather our part in it, is the only time frame open to change. When

teachers and students master the tools of analysis, they have mastered the methods for making deliberate decisions. They have mastered the tools for thinking through in advance the purposes, methods, and materials needed for accomplishing a goal, as well as the potential consequences of doing so.

TYPES OF ANALYSIS

There are three basic forms of analysis needed to perform general applications of Peirce's pragmatism: classifications (or taxonomies dealing with kinds of and sorts of); structure analyses (dealing with part-whole relationships) and; systems analyses (dealing with processes and structures moving through mental or physical space/ time).

The relationships made within any of the three types of analysis are based upon qualitative similarities and differences. In the case of classifications, the qualities may be of any sort (sense-based; attitude-based; logic-based). In the case of structure analyses, the qualities are usually reason-based, having mainly to do with space, size and materials—though sense-based and attitude-based qualities sometimes pop up as well (For example: the *dark* side of the house or the most (or least) *attractive* gate). System analyses usually use qualities that are reason-based (most particularly time and time/space). As often as not, however, classifications and structure analyses are integral parts of complex system analyses. Thus, it is safe to say that a good grasp of the forms, perceptions, and language necessary for making all sorts of qualitative distinctions is necessary for performing all three sorts of analyses.

ANALYSIS: A SUMMARY

Analysis skills provide a set of relational tools for making deliberate decisions concerning future behavior. The tools of analysis can be used for nearly any purpose—including for discovering and then constructing a purpose in the first place. We can use analysis to formulate new relationships as well as to analyze existing ones. With the tools of analysis (as Peirce conceived them), it is possible to both figure out meanings and to design new concepts as well (say in the form of analogies, metaphors, and other unique and unusual ideas). Analysis, then, is a relational tool by which it is possible to examine a potential or existing system, structure, or collection of things, facts, or ideas. The three basic forms of analysis necessary for engaging Peirce's pragmaticism are classification analysis, structure analysis, and systems (or operation) analysis.

3) INTERPRETATION

Reasoning, for Peirce, requires the ability to critically apprehend signs and their qualities; critically relate these to one another; and critically interpret, by means of inference, what they mean. One main sort of signs, such as images and drawings, are recognizable representations of something. Another type of signs point to, or indicate, something else (such as sneezing being a sign of allergies or of a cold). Symbols, the third main sort of signs, include words, numbers, musical notes, flags, and other signs that have no direct connection to what they stand for. Peirce contended that all meaning is constructed and interpreted by means of mental and physical signs. Because signs represent things, they are both the tools of and the products of qualification and analysis. Peirce's sign theory includes the interpretation and communication of both mental and physical signs. For Peirce, the concept that we call "reality" is consequence of the continuity of thought from one instance to another, and exists for us because we are capable of interpreting and communicating by means of signs.

The ability to understand and apply Peirce's concept of signs is crucial for developing higher level reasoning skills. Although many scholars are still dissecting the finer points of Peirce's theory of signs (semiotic), it is not necessary to understand these finer points in any depth in order to apply Peirce's sign theory to educational practice. There are two steps (albeit big ones) in learning how to use Peirce's concept of interpretation.

Step one is to simply learn how to identify the differences between Peirce's three main categories of signs: icons (representations of), indices (indications of), and symbols (which stand in place of). We learn to understand the meaning of words, things, and events by learning to read the signs around us. Just as signs provide the source from which qualities are determined and the categories for performing an analysis, the skills of qualification and analysis are brought to bear upon the interpretation of signs. The degree to which what we think and do is reasonable depends upon our mental abilities for qualifying, analyzing, and interpreting signs.

Step two involves learning to identify and apply the principles of context and matrix when interpreting the meaning of a particular sign. Context is what some call the sign situation. It is made up of all of those elements (actual or possible) within which a sign resides. In the case of language, a context may be the sentence or paragraph in which a particular word resides. In the case of an experience, a context may be the time, place, (and other, often invisible, factors) in which the elements of the experience occurs. The term "matrix" refers to an imaginary mental region in which a context resides. The matrix contains everything else in the universe *other* than the sign and the context

under consideration—that is to say, the matrix contains every potentiality which, if known, could contribute to or alter the meaning of the sign in question. This imaginary mental space holds everything that is not yet known about, but which, if known, might possibly affect the meaning of a sign and the sign situation (context). By learning to access elements from the matrix, learners of any subject can gain access to a more thorough understanding of whatever text (sign) they may be studying and whatever context (sign-situation) for which they may be studying it. Peirce did not use the term "matrix," but rather called this region "the continuum of uncertainty and indeterminacy within which all things swim."

INTERPRETATION: A SUMMARY

This brief discussion of Peirce's sign theory does not begin to address the depth and breadth of its applications. Peirce's semiotic has to do with the meaning of everything—how systems communicate and interpret one another; how we figure out what something means; how we discover new meanings; how planets, plants, and all systems (including ethical and aesthetic ones) operate. His sign theory provides a sound basis for the development of skill for both critical and creative thought.

Peirce's theory of interpretation (signs) comprises the core of his pragmatism and, thus, of his embedded philosophy of education. If educators are to help their students develop much needed cognitive skills for prospering in this information age, teachers need access to (and mastery of) the basics of Peirce's theory of reasoning. The basics of sign theory (which rely upon the skills of qualification and analysis) apply to everything that has to do with reasoning. Successful teachers who already instinctively apply these concepts will surely want to bring Peirce's sign theory into view by putting a common language on what they do. With a common language for the fundamentals of learning, those teachers having difficulties bringing about successful learning experiences for their students can be helped to achieve better outcomes. As students learn to apply the concepts of sign, context, and matrix to make interpretations of what they read, see, hear, and do, they build mental skills that have a direct connection to the making of effective inferences.

Conclusion

Our proposition here has been twofold:

- first, that the core purpose of teacher education should be to require that educators (and teachers of educators) master the fundamental set of skills necessary for applying each of

Peirce's three categories (qualification, relation, and interpretation) to the teaching/learning process,

- and secondly, that educators should develop the pedagogical skills for bringing about the will and the skills for learning in their students.

Teachers who themselves master these basic skills can then apply them within the curriculum of the subject matter and grade-level at which they teach. Having done so, educators will be able to generate methods for assisting their students in mastering the same skills to identify, analyze, and interpret experience. Every student who is capable of being educated (including learning disabled and educable mentally retarded) can master Peirce's reasoning skills to one degree or another, enhancing that student's ability to make reasoned choices about future behavior. Future behavior includes all that we do, from tackling the next lesson in trigonometry, to deciding whom to marry, to deciding what to cook for a potluck supper. People who know how to make good decisions by deliberately relating qualities of feeling, sensation, and reason have the means to make good lives for themselves.

The educational theory embedded within Peirce's philosophy advances the need for imparting the concepts and skills of qualification, analysis, and interpretation to educators who can, in turn begin to devise ways of transferring these skills to their students. Even a first-grade child can be encouraged to discern among the qualities of things while she is learning basic skills and general information. The ability to perform the skills of qualification, interpretation, and analysis (and to apply them for making appropriate inferences when reasoning), comprises essence of Peirce's pragmatism.

Therefore, to improve education, we first need to improve the minds of educators, meaning that basic competency for every teacher should amount to a mastery of the skills for engaging Peirce's three categories. Educators will then need to develop pedagogical tools for bringing about an appropriate level of mastery of these critical thinking skills for each grade level. The abilities to effectively perform the mental activities of qualification, analysis, and interpretation are essential both to the development of the "will to learn" and to the development of capability for rational thought.

Since nearly all problems plaguing our cities and communities worldwide have to do with the way in which humans make choices, the reasoning abilities of our general population is the best predictor of the kinds of future choices we will make. This means that the fate of society resides in the hands of educators. By using the embedded educational philosophy within Peirce's pragmatism, educators will have the tools for

bringing about a citizenry comprised of individuals able to apply well-developed reasoning abilities for solving the logical, ethical, and aesthetic problems of our society.

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Notes

1. Since the word "educate" is derived from the Latin term *educare*, which is a combination of *e*, meaning "from" and *ducere*, meaning "to lead," the original meaning of educate was "to lead from," not "to lead into." This is an important distinction for educators to keep in mind, as the Latin word for "leading into" is *inductare*, root word for the term "indoctrinate." ↵
2. Peirce scholars may argue that we cannot "teach" the ability to operate more effectively within the category of firstness, because, to do so, we would need to differentiate between qualities and would thus be relating qualities to one another, which is the activity of secondness. In this same sense, "talking about" such relating of qualities puts us into the category of thirdness (or representation). This argument is technically correct. However, we are not going to get stuck at this level of argument because we are seeking to apply the concepts of Peirce's pragmatism to the improvement of reasoning skills. In order to do that,

we must be able to deal with each of his three categories as if they were distinct and discussible frameworks. ←