THE PROBLEM OF VERACITY IN COMPUTERIZED EDUCATION
3990 word paper
170 word abstract

by
Donald V. Poochigian
Department of Philosophy and Religion
University of North Dakota
Grand Forks, North Dakota 58202
OFFICE: 1 (701) 777-2710
FAX: 1 (701) 777-4560
donald.poochigian@und.nodak.edu

Prepared for
ICETI and ICSIT 2010
Orlando, Florida
April 6th-9th, 2010

ABSTRACT

THE PROBLEM OF VERACITY IN COMPUTERIZED EDUCATION

Although humans are social animals, they can prevaricate. Prevarication is always possible because appearing like honesty and knowledge. Humans being resentful when discovering to have been lied to or misinformed, and distrustful when uncertain of being lied to or misinformed, society cannot survive if humans cannot detect prevarication. Society surviving, humans must be able to detect prevarication. As biological creatures, prevarication must be exhibited biologically if exhibited at all, and humans must have evolved the ability to detect it. A computer being mechanical, not biological, it can exhibit neither characteristics of truth nor falsity. Unformed and formed elements are observationally indistinguishable. Formed elements can be informed or uninformed, the prefix "in-" identifying "before." Observationally indistinguishable, being informed or uninformed is contextually distinguishable. Human biological character provides distinguishing context. Computer mechanical character provides no distinguishing context. Unable to judge credibility of the computer as teacher, credibility of what is taught by the computer cannot be judged. Either the computer educated must be credulous or incredulous, unable to distinguish truth and falsehood.

THE PROBLEM OF VERACITY IN COMPUTERIZED EDUCATION

> 'The Internet Chat Room as a Learning Tool:' . . . *is a truly authentic communicative device*. . . . the sense of real time is a little more forgiving than a face to face spoken encounter. Firstly, there is that all important thinking time between seeing what the other person has written and making one's reply. Secondly, there is the factor of anonimity [sic] which potentially increases the learners' confidence.[1]
>
> ***Technology can liberate the learner***. . . . students learn more from each other than from their teachers and administrators. . . . Today, . . . Internet chat rooms and threaded discussions . . . are in some ways better. . . . By their nature, the present generation of students is ready for learning technology. "Maybe we're just more, you know, advanced."[2]

INTRODUCTION. Assuming learning is becoming knowledgeable, a test of electronic learning is whether it facilitates knowing, which is an epistemological matter. Does it prepare the student for distinguishing between prevarication and probity? Foundational for these identities is "Visuo affective mapping," which is that "part of the human neural mechanism that allows us to interpret the actions of others in immediate, first person terms," and "In people with conditions such as Autism and Asperger Syndrome, this process has gone awry."[3] Excluding participants engaging in "first person terms," computer education proceeds as if they suffer "Autism and Asperger Syndrome." Even accepting "machines can enter into meaningful – if limited – social exchanges with human operators," it is not for naught the computer preoccupied are designated "geeks."[4]

UNIVERSALITY. Geneticists observe, "When we examine the living world, we see . . . individual organisms are visually clustered into collections that resemble one another more or less closely and are clearly distinct from other clusters."[5] Species being nominal—"resemble one another more or less closely"—then species characteristics are nominal, determined by axiomatic truth functions. A truth function identifying species as real, and evolution identified as constituent of the species, then no property being shared by every species member is explainable as incomplete evolution.

Accommodation is made by generally shared properties, designating their being absent abnormal, a pathological state. Following St. Augustine, an absent trait is presumed existing *en potencia*, assuming induction within an evolutionary convergent universe constrained by conservation of energy. Now common species properties become universal.

So proceeding, although humans can understand differently, order among them requires commonly conceiving reality to at least some extent. Otherwise any concurrence is impossible since individuals cannot arrive at an understanding by agreement, for this requires another understanding, and this still another, etc. Identified is "dispositional nature" in contrast to "constitutional nature." Constitutional nature is the criterion of class membership, and dispositional nature is the character of class members.[6] Since something can behave in any way and still be a class member, only after class members are identified is dispositional nature determinable.

Evolutionary theory provides a basis for "the human neural mechanism [allowing] us to interpret the actions of others in immediate, first person terms." Survival of a socially reproductive species requires members ordinarily behave credibly, there being no trust if not. Social interaction ceases without trust, a socially reproductive species disappearing, when evolution presupposes species seek survival. Consciously choosing

credibility being time consuming, when behaving credibly need be the norm, the extent to which a species member can pay to doing what is necessary to personally survive is diminished, endangering personal survival if credibility need be consciously chosen to occur. Because personal survival of every socially reproductive species member is endangered by consciously choosing credibility when species are presumed seeking survival, credibility among socially reproductive species members must occur unthinkingly generally.

Presumed is a genetic common sense whose extension[7] proceeds by consensual agreement, integrating genetic and consensual criteria.[8] However developed, "Explicit enumeration of"[9] elements is unattainable because "I do not know if any idea ever achieves complete precision."[10] Irrespective, "all that matters for a formal theory, is that the idea is sufficiently precise for what you intend to do with it."[11]

Accepting resolving ambiguity is by a name "'passed from link to link'" in a causal chain, identity is historic. Thus "a credible theory . . . . cannot gain, and it cannot deserve, credence if it disagrees with too much of what we thought before."[12] This is because the time consuming process of continually reconsidering how to behave is alleviated. Constantly considering self-preservation is self-defeating, minimizing doing what is needed for self-preservation, endangering the very self-preservation sought. Presuming species evolve in a self-preservative manner, such self-destructive behavior will be at least uncommon.

Additionally, assuming the human being a social animal, unable to fulfill desires independently of a division of labor, a name "'passed from link to link'" facilitates the communal order necessary for mutual sustenance. Proceeding thus, a common social resolution of ambiguity determining the limit of common sense is implemented. This avoids "the condition which is called war" where "the life of man" is "solitary, poor, nasty, brutish, and short."[13]

PROBITY. Social interaction being a criterion of human species identity, and species sustaining species identity, the human species sustains social interaction. Human species social interaction being consensual, probity is essential for it. A species characteristic being sustained genetically, the human species sustains probity genetically. Probity constituting a set of characteristics, the human species sustains these characteristics genetically.

Some characteristics are ambiguously shared by both probity and prevarication, though. Probity and prevarication sharing all characteristics are indistinguishable, probity not existing. Social interaction being a criterion of human species identity, and probity being necessary for consensual human species social interaction, probity exists. Therefore some probity characteristics are not shared by prevarication, these being unambiguous probity characteristics. Unambiguous probity characteristics are necessary for consensual human species social interaction nominally resolving ambiguous probity characteristics. Thus the human species sustains unambiguous probity characteristics genetically.

These "we can very freely *call to mind*," identifying intuitive judgment generally exhibited by humans to constitute genetically founded nature, corresponding genes identified ex post facto.[14] Such judgment can be linked to environmental markers to form a catalogue facilitating evaluation. Testimony can be immediate or mediate, face-to-face or not. Environmentally relative secondary properties accompanying primitive properties are relevant to identifying probity when not face-to-face. Excluding behavioral characteristics, mediate testimony necessarily presents numerically diminished probity criteria, rendering identity of its probity more problematic.

Difficulty occurs considering Ernst Zermelo's "'axiom of choice'" stipulating, "for any set whose members are sets that are non-empty and mutually exclusive, there exists at least one set having exactly one element in common with each of the sets belonging to the original set."[15] For any nonempty set, it always is possible to imagine a member constituent of another set, this composing a set limit. Such an element constitutes ambiguity, concurrently constituent of two or more "non-empty and mutually exclusive" sets.

Also rendered ambiguous are the sets containing the common element, either separate or joined, "*A* and *B*" or "*C*." Whether considering an element or sets, ambiguity is ubiquitous, deduction of an ambiguous element identifying a contradiction. Resolution of ambiguity being normative, resolution is nominal, preferential as so. Preference constituting free will, identity of a set at its limit(s) manifests free will.

Presupposition of dispositional probity among socially reproductive species members is not susceptible to scientific verification, because scientific verification presupposes it. Scientific challenge to the proposition, therefore, is self-contradictory. Assuming humanity a socially reproductive species, as biological science certainly does unchallenged by other sciences, then science as the set of all sciences presupposes human free will. Being so, prevarication is possible.

CONSCIOUSNESS. How, though, is prevarication known? By behavior, perhaps, or neural functioning. How, though, is relevant behavior or neural functioning known? If definitionally, how is definition known? If behaviorally or neurologically, how is this known without reintroducing the indeterminacy behavior and neurology are intended to resolve?

Resolution is by identity of phenomenal experience. But, this is unknowable by others, consciousness being observationally privileged. Only the public is knowable because observationally common. The public being known privately, though, how is it known the public is observationally common? Only if the private is universally accessible is universal accessibility of the public knowable.

How it is accessible is provided by Adam Smith's sympathetic sentiment. Hereby, "As we have no immediate experience of what other men feel, we can form no idea of the manner in which they are affected, but by conceiving what we ourselves should feel in the like situation."[16] Introduced is the phenomenal character of "consciousness" into the criteria of testimonial evaluation.

Thus, consciousness is not necessarily privileged. That phenomenal experience occurring when in another's circumstance *is* the other's phenomenal experience.

Entailed behavior not conforming to entailed behavior of the other constitutes inaccurately identified or altered circumstance of the other.

Empiricism is founded on the myth of a universal object effecting universal human sensory organs in a universal manner. Psychologism is founded on the myth of a universal phenomenon occurring in universal human consciousness in a universal manner. Only in the case of the empirically aberrant is consciousness deemed inaccessible, because presumed uncommon.

Both empirical and phenomenal character being nuanced, identity of both is iterative. Recursion and iteration are mechanisms of identity, determining the membership of a set. This occurs by a process of sequencing. Common to both recursion and iteration is identity of sequence members by analogy with an archetype, this archetype constituting the intensional criterion of sequence membership.

Distinguishing recursion and iteration is the nature of the identifying archetype. Each initiates with identification of a base case, but differs according to the nature of the base case. Recursion is essential identity from a constant base case, and iteration is accidental identity from an inconstant base case. Limit of an essential identity is necessary, then, and limit of an accidental identity is arbitrary.

Iterative, the empirical and phenomenal criteria determining testimonial knowledge are indeterminate. Veracity being conceptually indeterminate, testimonial knowledge is ultimately uncertain. Programming being determinately limited, computerized education presents a certain world, when human intercourse presents an uncertain world.

This is of concern considering how the human genetic criteria of probity and prevarication are extended to identify the nuance of individual human character. Primary is familiarity with real human beings, both as teachers and classmates. Secondary is literature. No computer can provide for the subtle differences of human physical and personal variation.

LITERATURE. Because biological social creatures, presumably the criterion of human testimonial knowledge has evolved in biological manifestation to foster social interaction. These criteria are learned in human interaction, which practically has limited extent. Its primary extension is storytelling, which introduces private and public manifestations of human character in diverse circumstances, facilitating judgment of the probity and prevarication of human testimony.

Being endemic to all human societies, this provides at least one reason humans appear so fascinated with literature. Relevant is the epistemological principle of testimonial knowledge. Testimony being fundamental to human social life, story-telling is the means by which we transcend personal experience, facilitating social interaction. Unfamiliar circumstances are sympathetically experienced, revealing the behavior and thought of participants.

However, critics of literature dismissively pronounce, "There are only so many stories." Unacknowledged is shared human nature endlessly divides into character subtypes. Literature models these character subtypes in compositional *characters*, both behaviorally and phenomenally, identifying constituents of character subtypes in the sequential order in which they occur. Composed is an axiomatic system identifying dispositional axioms defining a character type, from which behavioral theorems are deducible. Deductive derivation of textual depiction of a compositional character, in turn, verifies initial axiomatic characterization.

Quantum theorist David Bohm notes the indistinguishability of the observer from the observed until nominally defined.[17] Indicative is observer as constituent of the environment, until its limit is explicitly enumerated. Literary critics identify character in this extended manner, understanding its constituents and order relative to the extension of environmental identity.

AXIOMATICS. Certainty might be thought possible by substituting an axiomatic probity only incorporating objectively identifiable criteria. Presuming such certainty lends itself to the uninterpreted syntactic axiomatic system of a computer program. Interpreted semantic systems are still comparatively uncertain because referent can be indeterminate, even when not phenomenal, *practically* impossible to identify. Now, like the autistic, the "face to face spoken encounter" becomes unnecessary, so that, "we're just more, you know, advanced."

Sought is to emulate axiomatic mathematics. Often portrayed is axiomatic systems are syntactic and linguistic systems are semantic, superficially rendering axiomatic systems certain and linguistic systems uncertain. Presumed is the Logical Positivist differentiation between ordinary and logical language whereby,

> ordinary language is of such a character that rigorous logical analysis cannot be carried on within its limits. . . . In a logically perfect language the sense of every proposition is determined by the elementary propositions to which it is reducible. The rules for such a reduction are explicitly given in the proposition.[18]

Descent is from Rudolphus Agricola and Peter Ramus' groundwork avoiding Zeno's infinity paradoxes.[19] Basic are William James' "sudden *contrasts*"[20] and Ferdinand de Saussure's "process of segmentation"[21] within continuous consciousness. Constituted is the genetic intentionality[22] of Noam Chomsky's transformational grammar[23] rendering mathematical proof inconsiderate of anything "in between" functional identity.[24]

Alfred Tarski summarizes the format of an axiomatic system with, "In the . . . so-called *axiomatic method*, an arbitrary, usually finite, set *X* of sentences—an *axiom system*—is given, and the set *Cn*(*X*), i.e. the smallest deductive system over *X*, is formed."[25] If "a fully deductive treatment is aimed at," though, induction cannot be incorporated into what is identified as axiomatics.[26] However, if an "*axiomatic method*" is constituted by "arbitrary" "*assumptions*,"[27] and this is inductive, then induction is constituent of axiomatics.

Ignoring this provides false certainty, regarding necessary deductive argument, while disregarding unnecessary inductive argument necessary for generating it. If "an *axiom system*" is to form "the smallest deductive

system over *X*," it must be "well-ordered," consistent.[28] Arbitrariness of being "well-ordered" is revealed when considering,

> '[a world in which induction would fail as often as lead to truth] would not be disorder, but the simplest order; it would not be unintelligible, but, on the contrary, everything conceivable would be found in it with equal frequency.'[29]

Consistency is a matter of definition, incompatibility understandable as inconsistency of the law of the excluded middle, or clarification of casuistry.

Escape from indeterminacy is often thought possible by a "*formal consistency*; nothing more."[30] Precision is presumed possible with unambiguous syntactic place holders devoid of ambiguous semantic meaning. Meaning is ubiquitous, however, semantic indeterminacy unavoidable. Place holders have relational properties constituting their meaning, shown by their not necessarily being interchangeable, which they would be if place holding was wholly syntactical. Holding a specific place constitutes their meaning, rendering them not interchangeable.

INDETERMINACY. Mistaken is since "modern logic was designed with the language of mathematics largely in mind," when, "Most mathematical fields these days begin with a collection of undefined objects and a set of axioms which govern the behavior of the objects,"[31] David Hilbert reputedly concludes, "One must at all times be able to replace 'points, lines, planes' by 'tables, chairs, beermugs.'"[32] One is unable "at all times . . . to replace 'points, lines, planes' by 'tables, chairs, beermugs,'" or even by one another, lest they no longer be "'points, lines, planes.'" Indeed, one is unable to replace *this* point with *that* point, lest *this* point no longer be *this* point.

Since place holders have relational properties constituting their meaning, language is semantic, not syntactic. Elements differing in every occurrence, at least in time and/or space, place holding becomes the set of all possible occurrences of the place holder. Now language functions like Boolean algebra, a commutative sequence of overlapping sets whose meaning is the set of all common constituents of the overlapping sets. "Jane loves John" and "John loves Jane" illustrate sentences need not be commutative since love need not be reciprocal. Indicated is if a symbol has more than one meaning, syntactical location is an additional symbolic device identifying which possible meaning the symbol has.

Still, symbolism cannot completely identify meaning because it must be infinite. A computer program being deductive, it has the form,

A is *B*
a is *A*
Therefore *a* is *B*.

How is "*a* is *A*" known? "*A* is *B*" is insufficient because, "the sign for a function already contains the prototype of its argument, and it cannot contain itself."[33] David Hilbert's "distinction . . . between a subject matter under study and discourse about the subject matter" is required, a "discourse about the subject matter" constituting an extra-axiomatic axiom.[34] A "discourse about the subject matter" requiring its own "discourse about the subject matter," entailed is an infinite regress. Constituents of an axiom system being "arbitrary," identity of each subsequent "discourse about the subject matter" is arbitrary, there needing be no consensus on any. As individuals increasingly diverge in criteria individually identifying *a* as *A*, communal identity of *a* as *B* becomes increasingly unpredictable.

Convergence is assumable iff distinguishing common human genetic identifiers. Deception presumes disjoint phenomenal and physical occurrences. Evolutionary neurological manifestations being genetic, they are identifiable as manifesting psychological occurrences by mapping to phenomenal manifestations. Phenomenal manifestations are the primary psychological criterion, allowing prevarication.

UNDERSTANDING. For any axiomatic system, difficulty arises in identifying for "*An ordered set* $\mathfrak{M}$ *. . . a first element under the order prescribed for its elements by* $\mathfrak{M}$*.*"[35] How is "*a first element*" distinguished when a computerized axiomatic system is simply self-contained bits, "an electronic signal which is either on (1) or off (0)?"[36] Are the bits ungrouped or grouped, and if grouped, how grouped? Comprehension of bits constitutes the understanding objective of computer provided education. As "the smallest unit of information the computer uses," it is all the computer "understands."[37]

Educational content is *in*formed content, formed prior to presentation, which presumes consciousness.[37] Even wholly mapping computerized characterization of veracity to human biological veracity manifestations, it is unlinked to consciousness which is a condition of veracity manifestations. Identifying mind as neural not phenomenal, cognitive scientists overlook that neural events as autonomous or coterminous is observational indistinguishable. Formed and unformed elements being observationally indistinguishable, form is an abstract identification occurring only within consciousness.

Being unconscious, computers cannot distinguish formed and unformed elements. Whether the informational "bits" composing its program are coherent or incoherent are indeterminate to it. Indeed, a computer program is unidentifiable independently of a conscious identity of its constituents as such. Gilbert Ryle claiming mind as phenomenal rather than material commits a category error. He effects the ontological fallacy by reifying form. Alan Turing presupposing objectivity of a computer program recommits the fallacy by reifying form, as does Wittgenstein denying private language while affirming public language. Form is phenomenal, not material.

Understanding distinguishes formed and unformed elements. Formed elements are coherent, when coherence is a condition of understanding. Unformed elements are incoherent, when incoherence is a condition of misunderstanding. Understanding, in turn, is a condition of learning. A computer is unable to distinguish formed and unformed elements because unconscious, and students are able to distinguish formed and unformed elements because conscious. Thus electronic learning wholly depends on student achievement of understanding. A human can distinguish formed and unformed elements

because conscious. Therefore human learning depends on teacher and student achievement of understanding. A teacher can be *in*formed and a computer cannot.

CONCLUSION. Ultimately derivative of primitive biologic criteria of testimonial knowledge, axiomatic criteria of testimonial knowledge are not definitive. Biologic criteria verify axiomatic criteria by the shared membership of equivalency (*A*=*B*). Constituted is the ambiguous mutual limit of the biological metasystem and nominal axiomatic system.

Unable to transcend its program, a computer can train, it cannot educate. A human can train and educate. Training is familiarization with an algorithm. Education is familiarization with extension of an algorithm. So it is,

> a well-*trained* teacher is an *educated* teacher [who] above all, has a sense of the larger picture: the function of the specific lesson in the child's whole life and the function of his learning in the society's commonweal.[38]

Considering "there is the factor of anonymity which potentially increases the learners' confidence," opportunity for error is greater in "The Internet Chat Room" because avoiding the "little [less] forgiving . . . face to face spoken encounter." . . . or possibly not. Using devices such as "mood tones," perhaps "machines can enter into meaningful – if limited – social exchanges with human operators." ☺

NOTES

1.Adam Simpson, English Preparatory Program, Istanbul Bilgi University, "The Internet Chat Room as a Learning Tool," *Developing Teachers.com, A website for the developing language teacher*, Copyright 2000-2006© Developing Teachers.com, accessed Saturday, January 19, 2008,http://www.developingteachers.com/articles_tchtraining/cat_adam.htm, italics added.

2.Ron Goddard, School of Music, Brandon University, Canada, "Technology in Music Teacher Education: An Evolving Philosophy," accessed Saturday, January 19, 2008, http://music.utsa.edu/tdml/conf-VI/VI-Goddard.html.

3.Alexa Wright, Eugenie Shinkle, and Alf Linney, "Alter Ego: Computer Reflections of Human Emotions," accessed January 20, 2008, http://www.alteregoinstallation.co.uk/wright_shinkle_linney.pdf, 7.

4.Wright et al 7.

5.Anthony J. F. Griffiths, Susan R. Wessler, Richard C. Lewontin, William M. Gelbart, David T. Suzuki, Jeffrey H. Miller, *Introduction to Genetic Analysis*, 8th ed. (New York: W. H. Freeman and Company, 2005), 689.

6.Relevant is "**nature 1 a :** the inherent character or basic constitution of a person or thing : ESSENCE **b :** DISPOSITION, TEMPERAMENT," Frederick C. Mish, et al, eds., *Merriam Webster's Collegiate Dictionary*, tenth edition (Springfield, Massachusetts: Merriam-Webster, Incorporated, 1993), 774. Meant is by "**disposition 2 a :** prevailing tendency, mood, or inclination **b :** temperamental makeup **c :** the tendency of something to act in a certain manner under given circumstances." From Mish, et al, eds., 335.

7.Saul A. Kripke, *Naming and Necessity* (Cambridge, Massachusetts: Harvard University Press, 1980), 96.

8.Robert Audi, *Epistemology: a contemporary introduction to the theory of knowledge*, second edition (New York: Routledge, 2003), 135.

9.Robert Blanche, *Axiomatics* (London: Routledge& Kegan Paul Ltd, 1966), 22.

10.W. W. Sawyer, *Prelude to Mathematics* (New York: Dover Publications, Inc., 1982), *ft.* 2, 90.

11.Sawyer, *ft.* 2, 90.

12.David Lewis, *On the Plurality of Worlds* (New York: Basil Blackwell Inc., 1989), 134.

13.Thomas Hobbes, *Leviathan*, ed. John Plamenatz (Cleveland: Meridian Books, 1969), 143.

14.Audi 91.

15.Stephen F. Barker, *Philosophy of Mathematics* (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1964) 77.

16.Adam Smith, *The Theory of Moral Sentiments*, D. D. Raphael and A. L. Macfie, eds. (Indianapolis: Liberty Fund, 1984), 9.

17.David Bohm, *Quantum Theory* (New York: Dover Publications, Inc., 1989), 584-585.

18.Julius Rudolph Weinberg, *An Examination of LogicalPositivism* (New York: Harcourt, Brace and Company,1936), 193.

19.Elizabeth Flower and Murray G. Murphey, *A History of Philosophy in America* (New York: G. P. Putnam's Sons,1977), 14-41 passim.

20.William James, "The Stream of Thought," *Principles of Psychology*, in *Pragmatism: The Classic Writings*, ed. H. Standish Thayer (New York: Mentor, 1970), 142.

21.Ferdinand de Saussure, *Course in General Linguistics* (La Salle, Illinois: Open Court, 1986). [155-157], 110-111.

22.Franz Brentano, *Psychology From an Empirical Standpoint*, eds. Oskar Kraus and Linda McAlister, trans. Antos C. Rancurello, D. B. Terell, and Linda L. McAlister (Londonand New York: Routledge, 1997), 88-94.

23.Noam Chomsky, *The Minimalist Program* (Cambridge, Massachusetts: MIT Press, 1995).

24.Ian Stewart, *Concepts of Modern Mathematics* (New York: Dover Publications, Inc., 1995), 13.

25.Alfred Tarski, *Logic, Semantics, Meta-Mathematics*, trans. John Corcoran (Indianapolis, Indiana: Hackett Publishing Company, Inc., 1983) 40. Ernest Nagel and James R. Newman, *Gödel's Proof* (New York: New York University Press, 1986), 45-46.

26.Sawyer 90.

27.Alexander George and Daniel J. Velleman, *Philosophies of Mathematics* (Malden, Massachusetts: Blackwell Publishers Inc., 2002) 152.

28.E. Kamke, *Theory of Sets*, trans. Frederick Bagemihl (New York: Dover Publications, Inc., 1950) 52-53.

29.Murray G. Murphey, *The Development of Peirce's Philosophy* (Cambridge, Massachusetts: Harvard University Press, 1961) 345.

30.Sawyer 168.

31.John D. Baum, *Elements of Point Set Topology* (New York: Dover Publications, Inc., 1991), 1.

32.Carl B. Boyer, *A History of Mathematics, second edition* (New York: John Wiley & Sons, Inc., 1991), 610.

33.Ludwig Wittgenstein, *Tractatus Logico-Philosophicus* (Atlantic Highlands: New Jersey, 1974), nt. 3.333, 17.
34.Nagel and Newman 31.
35.Kamke 79.
3 6 .TekMom, " b i t ," www.tekmom.com/buzzwords , Copyright © 1998-1999 A n n e S a v a g e, http://www.tekmom.com/buzzwords/zdbit.html.
37.TekMom, "bit."
38."**in-** . . . *prefix* . . . before," Frederick C. Mish, et al, eds., *Merriam Webster's Collegiate Dictionary*, tenth edition (Springfield, Massachusetts: 1993), 585.
39.Kathleen Gershman, "Which Came First—the Training or the Ed?" (Grand Forks, North Dakota: Office of Instructional Development, University of North Dakota, Spring 2003), 1.