

A Social Construction of Intelligent Systems Design

A Vygotskian-Constructivist Literature Review

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The Social Construction of Intelligence

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Preface: Methodological Considerations

This paper will describe my integrative theory of intelligence. Because this theory assumes Vygotsky's premise that analysis and synthesis, operating at one and the same time is the highest form of conceptual thinking, I am using a conceptual-thinking methodology to create this literature review.

My conception of this methodology supposes that I explicate for the reader both the theory I have synthesized and the analysis of the literature that operated parallel to that synthesis.

This paper is my first attempt at delineating and using this methodology. Though I realize that there are still awkward aspects of my articulation and utilization of this methodology, I am hoping that the experience is at least coherent and at best illuminating for the reader.

I chose to use endnotes for referencing the literature in an effort to enable the reader to more easily read through the major premises the paper is setting forth.

Introduction: Herstorical Considerations

I remember new science. I remember hands-on experiments, teamworking, conceptual framing and quick passes over the history of the struggle for verification of knowledge-as-intuition we call Western Science.¹

I remember my partner in my experiments was tall, blond, a model in her after school hours, known to be not-as-bright as the others. When she was paired with me, the short, odd, bohemian-parented brainy kid, the class buzzed with excitement: surely there will be a cataclysm of some kind! A tsunami of frustration will result! No way those two can work together!

But we had the most consistently successful experiments and outcomes of any group in that class, and we never fought. My partner was completely uninterested in the logical sequences (following them or understanding them) necessary to build the contraptions we had to set up in order to stage our various forays into the mysterious working of physical phenomenon.

Physics epistemology bored her. But I am clumsy. I forget to concentrate on what's right in front of me, a young Ms. Magoo was I, no good at all at building the intricate setups I could design. I knew which designs would work and which ones wouldn't. I had the knack of abstract reasoning, but alone I would have failed every attempt to prove my well-reasoned theories. Alone I would never have been able to build any stable structures. Alone my partner would never have had the motivation to puzzle out the theses or the verifications. Without me she would have been in the cliché of today, clueless.

Clearly, the situation I am describing is an example of the disparity between knowledge-how and knowledge-that.² This was an instance which proved the efficacy of putting people to work according to the balance of those divisions.³

But I can also think of instances in which I cannot effectively operate/work from a split knowledge base.⁴ And, of course, there is the issue of how big a split is appropriate

for educators and educational systems to maintain between the knowledge-how worker and the knowledge-that worker.⁵

Hierarchies in societies around the globe maintain and promote a division of workers according to the quality of the work that they perform. Intellectuals are perennially attempting to associate themselves with the highest possible class of worker, meaning in practice that they fall into the existential trap of assuming the handicap of no hands-on-work.⁶

Active, engaged intellectuals (the sort this author prefers to associate with, promote and support) do not wish to get out of the work of applying their thoughts to the realm of the actual and taking the feedback from that reality. Ivory tower intellectuals, however, are famous for promulgating wasteful and dangerous ideas; ideas that cause damage, ideas for which they do not take clean-up responsibility.⁷

In order to raise a child to be healthy and as wise as possible, a mother cannot merely teach knowledge-that without knowledge-how. Parenting (the first teaching) is a combination of transferring both kinds of knowledge. Peer-learning, another natural phenomenon, reflects the same balance of modes. Even apprenticeships are examples of learning based on an integrated knowledge model. But when we examine schools we notice the pervasiveness of the division and of the divisiveness surrounding the division of knowledge models.⁸

This paper will cover the following points concerning our conceptions regarding the social construction of intelligence: 1) The point is not to *measure* how smart a person is and arrive at a comparable quantity 2) The point is what a person can *do* and what a person *is* in relation to her environment 3) The point is not how much a person *acquires*. The point is not the *acquisition* of anything 4) The point is subtler and more effective levels of *ethical interoperability*.⁹

Section 1: Quantification Considerations

The purpose of education is not to measure how smart a person is and arrive at a comparable quantity because intelligence is not a measurable quantity. The reason that we should not wish to measure intelligence as a fixed quantity residing within a person is that it offends the ethical precept of respecting people and not thinking of them, nor using them as objects. Quantifying any quality of a person as a form of valuation will always lead to discrimination in valuation.¹⁰

How much happiness should a person have at the age of seven to be considered normal? How will you judge the quality of emotion as happy? How happy is really happy? Is Sally worth more of our time as teachers or less because she is measured as happier than Julie?

We use this valuation form of dealing with people in our relations with them as instructors. But this method has been challenged repeatedly as an ineffective and unethical way of creating disparity and miseducation in classrooms.¹¹

I prefer a distinction between description and valuation. Since I strongly suspect that we are stuck with our human passion to count things, we might consider using this passion for the intrinsic benefit of our human systems and not for the maintenance of power elites.

Say that Sally and Julie are both in the fourth grade. We test their levels of happiness. We determine that Sally has a sixth grade level of happiness and Julie has a third grade level of happiness. How might we proceed with our information, using it for its descriptive power and resisting its evaluative potential? What if we told them their scores? Would they or their parents impose evaluation on this description? The deeper we immerse ourselves in this murky quantitative-evaluation-of-persons water, the more complicated become our ethical dilemmas.

I hope you weren't expecting me to solve this conundrum. This paper is neither a fairy tale nor a moral tale. If this paper were a fairy tale the characters would find a moral

integration and place themselves happily in their hierarchies. If this paper were a moral tale, perhaps the happier Sally would reach out with her excess happiness to help beleaguered Julie. If this paper was describing the United States at the end of the twentieth century, the happier Sally might entirely ignore the less highly rated Julie because of course, in our country, a girl would only be happier if she were also more popular, and we all know that popular kids ignore and vilify less popular kids. Educators in the United States, rarely, if ever stand up against our blatantly competitive systems. More often we ally ourselves as much as possible with whatever we consider to have the winningest potential. Until this changes we will see a worsening of school violence.¹²

We have drilled down into some very unpleasant social dynamics and we have only been following one variable that affects the social construction of intelligence: our belief in the efficacy of valuation of persons by measurable outcomes and criteria.

Section 2: Systemic Considerations

It is my thesis that intelligence is what a person can do and what a person is - both in relation to their environment.¹³

Happiness as a construct, measured, quantified, does not give us any information about what a person demonstrating that measured quantity, level of happiness, might *do*. I could be an extremely happy person and operate selfishly at all times. In fact, my happiness might be a result of my selfishness. If, then, we had a valuation of more happiness is better than less happiness, as teachers, we would be forced to accentuate Sally's selfishness because, in her case, it is the means to increase her happiness.¹⁴

Switching from the happiness metaphor to focus on intelligence, say Tom is measured to be far more intelligent than the rest of his class. Tom's intelligence manifests itself in mathematics and science but he is not known to have any close friends and he shies away from verbal expression. There are several sorts of valuation at work here: 1) we have measured his intelligence against a standard and 2) in relation to his peers 3) now we have a

choice of whether to value his math and science knowledge at the expense of developing a broader base for his intelligence, or to think of him as a person first, as a whole system which has within it interoperating systems, all dependent upon the functioning of every other.¹⁵

I propose functionality as a variable that needs to be considered any time we are describing any human quality.

We are human beings and spiritual experiences. A bumper sticker says, “We are not human beings having a spiritual experience: We are spiritual beings having a human experience.” I do not agree. To my mind, as an educator, it is important to consider that we are spiritual experiences having a human beingness. Spirit, by definition, is not a beingness. A spiritual being is an interesting metaphor, an attempt to bring the immaterial into imaginative manifestation but beingness is, by definition, corporeality.¹⁶

In our states of corporeality we enter into relationships with other corporeal entities. The complexity of intra and inter relationships is our social reality. Within our social reality, we are responsible for the functions we carry forward, initiate, deny or condemn.¹⁷

Actions are clearly functions. Less clearly, relationships are also functions.

What is the function of Sally’s happiness? Does it make her healthy physically, it is the result, at least partly, of physical health, stamina? Does Sally’s happiness strengthen her ability to function compassionately towards herself and others? Or does Sally’s happiness increase her isolation? How do the people in Sally’s peer group react to her? Are they competitive? Cruelly competitive? Excitingly challenging? From a systems perspective these are the pertinent questions for Sally’s teachers to be asking, both about her happiness and as regards her intelligence.¹⁸

Let’s say that Sally is gifted in English, that she can read at a grade level two years higher than her peers, that she can write clearly and effectively. As her teacher we could value her achievements as ends in themselves or choose to engage in the protracted experiential analysis of Sally as a complexity of qualities with the potential to learn to

function with the inclusionary self respect of regarding all her qualities as equally important. As her “teacher,” each of us participates in her learning and we can allow ourselves the awareness that we, along with her peers and family, make up her psychological environment.¹⁹

The tendency will be for us to find answers to these questions. I am suggesting that we allow ourselves to remain longer with the questions, to not go immediately to solving Sally. My goal is to prove that Sally is not quantifiable, not solvable; that we are embedded in a functional reality with Sally; that our open-ended wondering can leave Sally with plenty of room to grow and achieve and keep us (her teachers) from forgetting that our growth and our sense of achievement is intricately interwoven with hers.²⁰

The emphasis on describing Sally as a series of letters or numbers and then describing Sally’s teacher commensurately with those numbers, belittles the gorgeous complexity of the human experience of teaching and learning.²¹

Teaching and learning are simultaneous acts. Learning is the moment that you teach yourself, that moment in which you incorporate into yourself an awareness that affects the structure of an aspect of your consciousness. Teaching is the moment that you learn about another person’s moment of learning. We want to avoid the awareness of the intimacy of those moments. But by avoiding this awareness, we allow ourselves to lessen the intimacy of those encounters. As soon as we lessen this intimacy, we have the grounds prerequisite for the interpolation of hierarchies into an educative system.²²

It is neither possible nor desirable for all teaching/learning experiences to occur deeply, intimately, profoundly. But it is important to realize that the profundity of the learning, and hence of the resulting intelligence will be proportional to the intimacy of the experience.²³

Mass education is a relatively new concept in the intellectual history of our earthly civilizations. The United States was the first to seriously attempt the creation and formulation of an egalitarian mass education system and is still at the forefront of

determining the potentials and limitations of that system. Learning to balance the practical and ethical implications of mass education systems should be considered an ongoing, continuous process, not a “problem” to be solved.²⁴

Section 3: Process Considerations

My thesis is that intelligence is not how much a person acquires. Intelligence does not involve the acquisition of any thing, but may involve an evolution of the process of incorporation.²⁵

The current education mythology accepts the premise of the acquisition of knowledge. This assumption is based on an analogy with the trade of material goods. The fact that I can physically buy and own two chairs is considered essentially equivalent to the fact that I can mentally hear and remember two dates. From the assumption that the primary function of the brain is acquisition, we derive most of our memorization techniques, our testing strategies and our stage theories. From this same assumption we derive our conception of brain capacity being measurable and of the brain being able to contain quantities of information.²⁶

If the brain’s functional capacity that we call intelligence is conceived of as a filling up and a utilization of space, an efficient storage and retrieval mechanism is all that is required to make this intelligence operate at its highest capacity. Somehow we instinctually know/sense that there is much more to intelligence than this metaphor can sustain.²⁷

According to Vygotsky (1962) and Bakhtin (1981), the basics of thought are internalizations of external experiences of relationship. Vygotsky maintains that we only gradually learn to operate our minds separately from externals. It is not difficult to understand that our experience of accumulating substances to aid us in survival (food, shelter, tools et alia) could have been extrapolated to a metaphoric understanding of how the mind works. The history of science shows us how wrong an original metaphoric conception of the functional mechanisms of the world can be. Let’s examine an alternative

conception of brain organization based on more recent understanding of the interrelationship of interlocking systems.²⁸

The brain depends upon our sensory mechanisms for its inputs. There are interesting parallels between the various sensual mechanisms. All the senses bring the outer world into us. Our sight allows a sort of stimulation we feel is bringing us spatial reality. Our ears do the same as well as functioning as receivers of linguistic data. Our smell distinguishes between what is living and what is dying; what is ready for procreation, what is not. Our sense of touch helps us choose what foods we need to ingest corporeally. All the senses are ingestion mechanisms.

Ingestion is qualitatively different from accumulation. Accumulation posits no alteration in the basic state of either the accumulator or the accumulated. Whereas ingestion supposes an annihilation of the ingested as it is transformed and integrated into the system of the ingestor, thereby transforming the ingestor. Note: you are what you eat.

What the brain does is ingest not accumulate. This should not be surprising because the sensory mechanisms which are an extension of the brain (or, more accurately philogenetically, from which the brain is an extension) are transforming and assimilating. In no way do the senses accumulate; therefore it is highly improbable that the brain functions in any manner akin to accumulation. If the brain was able to accumulate we would be able, with our present state of technology, to see evidence of this accumulation, an increase in the size, in the mass, of *something*. But we don't. What we do see is a variety of pathways which are more or less intensively used. Perhaps a better metaphor for the way the brain works is our highway system, or the grass paths that students make on their way to class, or our own circulatory system, and of course the brain exhibits tremendous similarity to the functioning of our central nervous system. This last cannot be considered a metaphor, since, in reality, we are observing the extension of process (nervous system) into ever more discreet and highly particularized functionality (brain).²⁹

What are the implications for a consideration of intelligence if the brain does not accumulate but instead ingests?

If the brain accumulates, it makes sense to expect students to fill up their storage-like brains with facts. If we believe that accumulation is the nature of the brain then the highest use of the brain must be the ability to contain, search and retrieve the most amount of knowledge/data/information in the shortest amount of time. If the “best” use of the brain is a vast accumulation of information, and if the “best” intelligence is a reflection of that accumulation, then it is sensible to test, to count *how much* has been accumulated and *how fast* that accumulation can be retrieved.³⁰

If however, the brain ingests and is a distributive mechanism, an extension of the senses, evolved for the purpose of healthy, vital interaction with the external environment/world, then intelligence (the adaptive use of the brain) would be the ability to vitally, healthily, interact with the world. If intelligence is a reflection of healthy interaction then a consideration of the “best” or the “most” intelligence is incomprehensible outside of an analysis, a consideration of the person’s sensitive dependence on the environment.³¹

If we accept a model (myth/symbolic representation) of the brain as a mechanism, intricately woven (by means of relationship) into the fabric of externals, how do we evaluate intelligence? If we evaluate intelligence in terms of the quality of relationships it evokes, we cannot use strictly quantitative measures. The movement towards the use of qualitative research methodologies has been in great measure inspired by this very realization.³²

Action science and action research propose to us the fundamental principles of relationship as the critical factors in all change. Learning is defined by the action science faction as change. They posit that learning can be measured or assessed by its impact on its surrounding organizations. Unfortunately, by these standards, most educational institutions reveal themselves to be anything but learning institutions and this, I believe, is one of the

reasons action science has not been embraced by many otherwise seemingly forward looking universities.³³

But, happily, action science's brain child, qualitative research, has converged with the ever increasing numbers of women in higher education to create what appears to be an astounding revolution in methodology that *could* very well change the focus of educational reform from tests of speed and skill in epistemological referencing to an emphasis on interpersonal relationships and a close examination of what aspects of institutional structure and curricula increase or decrease the potential for healthy inter and intra personal relationships.³⁴

Section 4: Ethical Considerations

My thesis is that the purpose of education is to enable intelligence to assume subtler and more effective levels of ethical interoperability.³⁵

Accountability at present sends chills down my spine. Accountability carries with it connotations of punishment based on mistakes. I submit that every talented and successful teacher knows that learning requires mistakes; that mistakes are by far the most interesting, critical points in an educational journey. To ally punishment with mistakes, even connotatively, is to strangle, to suffocate the learner. The more conducive an environment is for the making of mistakes, the more trust that can be generated in relationships, the more likely it is that our sensory mechanisms will increase their rate/efficacy of functioning and therefore, by definition, relating and more learning will occur.³⁶

In the cases where I worked parallel to other teachers, each of us responsible for an equivalent number of students, I posit that the degree to which my students so far excelled the students on other teams is directly proportional to the degree of trust our team had generated amongst ourselves.³⁷

How did we generate so much trust? By removing constraints. When I was in a position to explicate the rules of the system I was working for/within, I did so, clearly

explaining to what degree I, as an autonomous individual agreed or disagreed with these rules. I made it clear to my students my opinions concerning where the institutions were flexible and where they were not. I treated the system as a dangerous enemy as well as a beneficial overlord. This, I feel, is the truth of the matter for those of us who do not feel that the systems extant represent our needs and our interests. We are not given the right as students and teachers to determine the rules nor are we permitted to change the systems within which we work.³⁸

I did not ask my students and I do not ask my peers, to trust me. Trust is an organic element of the dynamics of relationship, it can be strengthened or weakened, thereby strengthening or weakening the potentials of the collaboration of its participants but it cannot be bought or otherwise exchanged.

We are always in collaboration whether or not we are aware of being in that state. The importance of defining and delineating the individual cannot be denied and all learning must stem from the individual's desire and will (their motivation) to learn (grow). However, it is counter-productive to pretend that an individual's growth is not intricately interwoven with their surrounding circumstances and the people with whom they come into contact.³⁹

When one person in a system grows, the entire system must change. Similarly, every individual in a system has the responsibility to determine the nature of their own change/reaction. Teachers, as authorities must not be too quick to judge a person's reaction to change. For instance, if Sally wins a huge prize and Julie reacts negatively and acts out angrily or depressively, Julie's reaction, even though negative, with respectful responses from her teacher and peers, might become an educative (in Dewey's sense) experience. But if Julie's negativity is prematurely judged and labeled negatively, Julie's ability to learn/change/grow will be stunted thereby (maleducative in Dewey's terms).⁴⁰

Teachers, working with integrative, relationship oriented constructs, understanding that everything is connected to everything else, must dare to risk our actions backfiring. All

actions backfire. Actions forward fire and backward fire, they impact, in fact, in infinite directions. Remembering that teaching and learning are the same thing, that they happen in the same moment; that learning takes place most profoundly in the moments which are generally considered to be “mistakes.” When we make mistakes, in any role we play in our lives, we are experiencing the potential of learning.⁴¹

Being “right” in the cliché school sense, can only ever be routine: to be right in the way that everyone knows you are right can only happen if your responses are pre-formulated. A pre-formulated response is not thinking in any serious conceptual sense, it is merely a manifestation of a reactive function.⁴²

Teaching people to think involves putting oneself in the position of learning. The best thinkers are learning in every instant, walking a tightrope of immediate experience, balancing competing forces, staying in connection with the “other person” whether that other person is an actual person engaged with them in living collaboration or a person represented in a book, an article, an idea, a song or a theory.

The only way to know or judge the ethics of one’s position as a teacher/trainer is to be completely immersed in the collaborative act of teaching and learning and to sense one’s own level of self-respect and respect for the other. When we remove ourselves from ourselves (usually through thoughts of shame emanating from harsh judgments) we deny self respect. When we withdraw from another and create a distance between each other (usually through the fear of hurting or being hurt ourselves) we are defending ourselves and losing a chance to connect.⁴³

We can teach people we don’t like by staying with that honesty and working with that dislike. Creative collaboration must include mechanisms for creative conflict. We learn perhaps more about ourselves when someone disagrees with us than we do from casual agreement. Boundaries are necessary definitions and allow us to make the classifications which themselves are necessary tools for thinking.⁴⁴

For the most part what we teach and test for in education today are the tools used for thinking. We don't actually test intelligence or even the efficacy of our thinking. We are far more concerned with knowing than with thinking and intelligence as an integrative human faculty. To the extent that we even consider thinking today we trivialize it by characterizing it as a game called problem solving. Problem solving is an important strategic mechanism but only one very small ability of the mind and, according to Vygotsky, a far more primitive ability than conceptual thinking.⁴⁵

As long as our systems and institutions are scared of change, teachers won't be allowed to teach people to think. Thinking is so intimately intertwined with growth, love and human relationships that it presents a most serious threat to those systems and institutions whose vision is dichotomous and whose purposes are ruinous to the human as well as to the larger encompassing ecological environments.⁴⁶

Section 5: Qualitative Considerations

Vygotsky is still the foremost (because the most thorough) theorist of the social construction of intelligence. Vygotsky delineates three main categories of thought: heaping, complexes and conceptual thinking.⁴⁷

The simplest form of thought consists of making heaps, seeing similarities and differences and being able to sort the elements of the world into categories based on these distinctions.

Vygotsky names three types of thinking actions that use this unorganized heaping technique: 1) trial and error 2) visual association and 3) two-step logic. An example of trial and error heaping would be to associate objects by randomly choosing them, then comparing them to see if they fit in some way. Visual association creates heaps of similar looking objects. An example of two-step logic might be - step 1) I like it and step 2) so put it on the pile.

Thinking in complexes involves a more complicated set of mental activities than the actions required for thinking in heaps. Vygotsky names five types of complexes: associative complexes, collection complexes, chain complexes, diffuse complexes and pseudo-concepts. According to Vygotsky, the highest stage of thinking is thinking in concepts.

Both the associative and the collection complexes advance the basic heaping thinking skill of identifying characteristics. Associative complexes are made by grouping according to similarities of identified characteristics. Collection complexes are created by grouping objects that are isolates from a larger group. For instance, identifying all the blue eyed children in a group of school children with a variety of eye colors, is an example of collection complex thinking. Racists often use this type of thinking. Vygotsky states that the characteristics that determine the associative and the collection complexes are concrete and factual. The connections made in the mind when using these two complexes for thinking can be either objective (qualities inherent in the object) or subjective (qualities evoked in the thinker in response to the object).

Vygotsky characterizes as having no hierarchy (note: hierarchy is a second order structuring). Chain complexes are a more complicated version of associative thinking, each characteristic linked sequentially. Chronologies and linear progressions are examples of chain complexes.

When the mind uses diffuse complexes to think, generalities can be made beyond concrete experience, thought can be extended to analyze things not necessarily perceivable by the five bodily senses.

Pseudo-concepts are organized generalizations. They are similar to diffuse complexes but also organize the generalities into some sort of sequence. Rule and example sequences are pseudo-concepts. Hierarchy trees are pseudo-concepts.

What distinguishes conceptual thinking from thinking in complexes is the fact that conceptual thinking is entirely abstract and is distinguished from dreaming by the fact that

concepts order mental structures by the simultaneous use of synthesis and analysis.

Whereas in complex thinking we can only synthesize and analyze one at a time.

In Vygotsky's schema the first mental skill of identifying characteristics can lead (in healthy individuals) progressively to more subtle configurations of associating likes or comparing dissimilars. Association becomes the ability to synthesize. The ability to compare and contrast (dissociation) evolves into analytical ability.

Vygotsky's definition of conceptual thinking as the ability to synthesize and analyze at one and the same time is, in essence, to ingest, transform and integrate sensory and non-sensory data, to make it one's own, to think for one's self.

Section 6: Design Considerations

In developing technological support systems for educational purposes, it is important to remember that the formal organization of systems and information presupposes and recreates whatever fundamental theories of relationships is underlying in the consciousness of the human beings composing and creating those systems.⁴⁸

There is no "where" a system designer can find herself in which a system is not already in place and, to some degree, functioning. The first challenge for any systems designer is to observe and analyze the prevailing systems within which their "new" system will attempt to fit itself functionally. If the systems designer is able to think conceptually, part of this challenge will be for her as she enters into relationship with the surrounding system, to allow herself to integrate/ingest the system and be integrated into that system in order to synthesize as she is analyzing.

Using traditional instructional whole systems design theory, the second step would be to determine to what degree instigating change in the prevailing system will be necessary and beneficial for the contracted purpose the designer has been hired to facilitate. Using Vygotsky's model of thinking, it will then be necessary for the designer to continue to merge her analysis with her sense of the creative potential (similar to the zone of proximal

development of individuals) of the system into the synthesis we normally refer to as the design.

Designers can only think with their own minds and their minds are just as inextricable linked to their environments as anyone else's. In most instructional technology designs the underlying suppositions and theories are transparent. The primary operational theory of the brain (that I have been carefully delineating in this paper), that of a storage mechanism, has been the primary determinant of instructional design models.⁴⁹

A crude relationship model, at present represented by the neural network model, is used extensively for industry and military applications but far less often for educational purposes. In part the use of this model for education purposes has been hampered by the expense of its implementation. A more complex model of artificial intelligence, blackboard architecture, is far more flexible than any other computational device we have developed up till now but the development of this model has been classified for military purposes.⁵⁰

In the absence of both high-tech neural-network-type design software and blackboard architecture software, an instructional designers hoping to create educational systems that promote high levels of relationship are choosing the option of multi-media platforms. Most tech designers use multi-media platforms like Authorware and Director. These programs allow the designer tremendous latitude in creating multiple pathways and non-linear logical progressions while at the same time allowing the training institution to collect data on anything from time taken to complete, number of trials, numbers of right and wrong answers. These methods are powerful systems with tremendous potential (some still unexplored). However consider that it might be more beneficial to educational designers to define multi-media as a *variety* of media and to consider using a variety of media in each learning experience.

The challenge for the instructional designer is to work within extant systems. Mixing media can create a learning environment with the greatest potential for the highest levels of connectivity between the learners and what needs to be learned.

It is not in our interest to do away with live human interactions in education. When we isolated Vitamin C as the element in an orange that made that fruit beneficial to ingest, we did not realize the importance of bioflavonoids. We can't be sure that we know *all* that a teacher is worth in a classroom to make it a viable choice to replace her with a non-human systems? The missing bioflavonoid factor will be found in the intricacies of human relationship. The intensity and power inherent in human connectivity can never be replaced by a machine because human beings make the machines and we can never stand far enough outside ourselves as humans to be sure that we know all that it means to be human. Therefore there will always be an element of mystery, of magic in the experience of learning and teaching.⁵¹

The role of technology is to support human learning systems. Educational systems that are transparent and modular, flexible enough for a teacher to pick and choose to suit her particular situation, will meet the criteria of respect for persons outlined in the first four sections of this paper.⁵²

Instructional systems designers often denigrate the role of the teacher. The teacher is limited in their knowledge, whereas an electronic system has, theoretically, the capacity to deliver infinite information. The position that relationship and mutual exchange are fundamentals of learning, stands opposed to the position of instructional design that furthers the disempowerment of teachers.

Even though a system is theoretically infinite, in actuality it is completely dependent upon its makers and cannot be quickly altered (in its basic organization) once it's delivered. This makes the information system more rigid than most living teachers. A teacher who is in the presence of her students can provide affective knowledge and reassurance a teacher at a distance can never provide.

Corporeal reality demands the corporeal presence of others. We know that babies won't thrive without human touch. If learning is a mutual condition of relationship, the

corporeal presence of the participants will be the most mysterious and complex relationship possible (because of the limitlessness of the factors).

I can and have learned a great deal from books by people I have never met and yet we all know that moment when something we only know from our reading suddenly becomes something we know in actuality. Most of us acknowledge that when our learning becomes actual, it is far more profound and life-effecting than when it remains merely the knowledge-that we get from books.

It is important to integrate teachers in all instructional designs in such a way that they can feel ownership of the systems and their functions. At present teachers are held to strict levels of accountability for systems they do not understand and often don't agree with. Using systems theory, we can see that, because instructional systems are put in place without the teachers (who are meant to implement those designs) prior agreement, the pressure on the teachers invariably translates into an even more severe pressure on the students.⁵³

Conclusion: Final Considerations

Contrary to the present systems that promote an arbitrary and mechanical quantification of intelligence and achievement, I submit that, since practice makes perfect, we must not score practice in a way that demeans people and hampers learning.

Contrary to the present educational systems that promote competitive and lonely models of the pursuit of knowledge, I submit that, since all learning is an aspect of relationship, we must encourage healthy relationships by valuing and modeling manifestations of creative collaborations.

Contrary to the present educational systems that rely on the model of the brain (and the person) as acquirer, I submit that valuing ownership above all else divides people and creates deadly hierarchies. We must value the learner as teacher, engage in egalitarian

dialogues at all levels of education and value above all else the relationships students create with their peers, their teachers and their families.

Contrary to the present educational systems that value aggressive competition, I submit that the pain expressed at the Columbine High School disaster can be avoided by our valuing and actively promoting viable internal (intra individual) and external (inter individual) methods of ameliorating polarization and creating a supportive diversity in educational environments.

Endnotes

¹Koestler (1964) puts forward a proposition that all science and all knowledge originates as an intuitive grasp and that creative inspiration is then followed up with painstaking, detailed analysis and proofs. Brown (1963) describes the underpinnings of Western science, showing us how profoundly we depend upon our theories of causality as a fundament to our technologies and our conception of knowledge.

²Apple (1979) writes passionately of the negative social ramifications of the institutionalization of the polarization of knowledge. Aoki (1999) proposes that teachers and educational theorists find a middle ground, more in line with experience as we find it in the classrooms.

³Arnot & Dillabough (1999) remind us of our responsibilities as curriculum designers to not leave out women. Their approach can be applied to any cultural group that is not yet represented in our curricula and educational structures. Bateson (1979) argues that we are a part of nature and that we can find a way to realize our necessary integration with the whole of our environment.

⁴Dewey (1938) argues that experience is the basis of all learning, and implies, in every step of his argument, that there is no internal split in us. Leonard (1968) argues that education can be joyful, that we can learn with the whole of ourselves, that we do not need to split learning off from the life within us. Langer's (1997) position is that we need to teach integrated knowledge to help people use their minds in an integrated fashion.

⁵Tarrant (1991) argues that the divisions we maintain in the educational system are contrary to the moral imperatives of democracy. Hyland (1993 a, b) discusses the complexities of the situation in the UK regarding vocational education; even though it is important to validate the knowledge-how workers, denying them knowledge-that is not an acceptable alternative. Apple (1982) examines the vested interests that keep education functioning for the benefit of elites in our supposedly democratic educational systems. Illich (1971) calls for the end of the educational system as we know it, insisting that the "banking" system of

education can never be anything but corrupt. Hirst (1974) asks us to consider a new sort of division of curricula, not based on class but on content areas.

⁶Durkheim (1972) proposes that we consider the depth to which class and social divisions affect how and what we think and know. Degenhart (1982) examines the value systems that underlie our educational assumptions. Ray's (1993) article applies Durkheim's ideas to the broad cultural and educational issues global educational programs are presently faced with. Rogers (1967) gives us an affective purposive reasoning to defend the position of engaged teaching.

⁷ Arendt (1978 a, b), as a Kantian, develops concepts of thought as an ethical mechanism. Kant (1781) believes in the soul and argues that it is each one of our responsibility to live respecting our souls and the souls of others. Cassirer (1996) attempts to weave an intricate explication of thought's embeddedness in the functions of life.

⁸Holt (1964, 1967) is still my favorite explicator of the position that schools can damage people with their unremitting emphasis on failure and criticism. Illich (1971) proposes that teaching and learning are perfectly natural phenomenon that would take place with or without schools' existence. Freire (1973) understands the class bound nature of schools and promotes educators entering the world and lives of their students. Ruddick (1989) makes a brave attempt at showing how the values we bring to raising children can be brought into the public sphere on all levels for the nurturing of the world.

⁹ Resnick (1991), Kant (1781), Shotter (1993), Arendt (1954, 1978 a, b), Vygotsky (1962, 1971, 1993 a, b), McDermott (1977), Bateson (1972), Davidson (1983), Cassirer (1957), Dewey (1916, 1938), all argue for the significance of ethics in education and the training of thinking.

¹⁰Dewey (1938) stands firmly against evaluation of people against any standard. Grovogui (1998) in this article proposes that what can be effected in international relations is hampered by the languages we use for the negotiation of power. The way these languages are structured, he contends, mitigates against peaceful resolutions of conflicts. Hegde

(1998) discusses the importance of respecting alternative cultural value systems. Hernstein & Murray (1994) blatantly push their racist, classist position, attempting to further the encroachment of quantitative procedures for evaluating intelligence that we inherited from the same philosophical principles that led to Nazi racism.

¹¹Dewey (1916) believed that an experience can be miseducational if it keeps people functioning with low level habits of thought. Orbe's (1998) article articulates inclusive ways of viewing the behaviors minorities exhibit when confronted with social pressures to conform. Randall (1995) explains how we come to believe in the stories we tell about ourselves. Gersie (1977) has developed a methodology for changing the stories people tell themselves about themselves.

¹²McLaughlin (1994) explains that we must think with our spirits as well as with our minds because it isn't only our minds that are affected by what we do. Miller (1980) shows us how the cycles of abuse hinge on people's inability to identify with their own victimization, stand up against the wrong and move on. Bauman (1993) explains in great detail how we can move into social responsibility in the modern world. Buell's (1998) article explores how the language we use to deal with pollution affects what we can actually do to alleviate the damage pollution is wreaking on our planet. Maslow (1971) argues that we must teach people to be the best that they can be.

¹³Miller (1995) explains how we are embedded in a series of interlocking living systems.

¹⁴Hirschorn (1988) shows us how we create institutions that are anhedonic, unable to be joyful, stuck in punitive, compulsive cycles.

¹⁵Mink (1989, 1993 a, b, c) Kurtzman (1998), Senge (1990, 1998, 1999), Lippitt (1982), Scott (1981), Harvey (1975), Miller (1975), Guzzo & Shea (1992) are some of the many articles and books describing the efforts being made to construct human interaction theories based on system theory principles.

¹⁶Cassirer (1955 a) argues beautifully for the embodiment of thought. Dewey (1938) argues passionately for the embodiment of learning. McDermott (1972) compiles William

James' work, developing our understanding of the uniqueness of individual consciousness and the importance of pragmatism. McCulloch (1968) argues that machines can never replace people because they cannot feel or think the way we do, because they lack viscera. Varela (1991) shows us how we cannot and should not wish to escape our bodies.

¹⁷Nussbaum (1990, 1998) argues for the social responsibility of intellectual endeavor, and its grounding in love and respect and especially careful reasoning. O'Hare (1999) argues that educators must acknowledge the damage they may unwittingly do with their sexist frameworks. Velleman (1999) makes a convincing argument that love transcends a merely Freudian lust, expanding love into a Kantian framework of respect for the soul of another living person.

¹⁸Mink (1993b) argues that people need to feel trust in order to do their best. Argyris (1980) contends that truth and trust are basic necessities for the healthy functioning of human organizations.

¹⁹Rogers (1967) is a proponent of the teacher as engaged learner, entering into systems *with* the learner, refusing the authoritarian role. Shotter (1993) proposes that we create reality together by the way we engage in dialogue. Vygotsky (1962) maintains that what all people need the most is to be accepted by the people in their life. Bakhtin (1981) articulates the position that language is the basis of thought.

²⁰Oyler (1996) shows how a teacher is part of the learning. Tarrant (1989) insists that the teacher has a moral responsibility to engage in substantive conversations with students. Swidler (1979) shows us how organizations can work without hierarchical, punitive structures supporting them. Orlikowsky (1995) explains that group dynamics will always override the technology.

²¹Hernstein & Murray (1994) would have us believe that what matters about people can be statistically discovered. Hin's (1999) article maintains that we need to be in connection with nature if we wish to be able to experience the sublime in ourselves. Hirschorn (1988) shows us how we need to be in touch with our feelings to correctly assess our thinking.

²²Goldstein (1997), Oyler (1996), Randall (1995), Gersie (1997), Mink lectures at UT (1999), Spinoza (1883), and Schutz (1999) all promote our awareness of the teacher's intricate connection to the events connected to learning.

²³Reynolds (1997), Platts (1996), Pellegrin (1995), Moyles (1994), Lewis (1996), Bennet (1997), and Morris (1980) are all play theorists who promote the concept that play (a profoundly intimate experience) is a reliable and viable source of learning.

²⁴Tarrant (1989) takes on the challenge of inventing a democratic education. Brookfield (1982) outlines some of the possibilities for ways of thinking about autonomous thinking. Rush (1957) describes the development of western European mass education as originating with the ecclesiastical urge to help the poor, being handed over to government in the interests of business in the eighteenth century. Gilligan (1988) delineates alternative value systems based on gender. Ball (1977) is one of many writers searching for an autonomous motivator to discipline students to their studies. Brandes (1986), Boud (1988), Lewis (1986), and Tennant (1995) describe various aspects of developing student autonomy. Dewey (1916) in this and all his writing works indefatigably to identify parallels between pragmatic liberal educational theories and democratic principles of life and government.

²⁵Bakhtin (1981) and Shotter (1993) explore the close relationship between language, thought and culture.

²⁶Hernstein & Murray (1994) are the perfectly conservative laissez faire capitalist apologists, with a system for using statistical accounting procedures to value people in the context of their commercial potential.

²⁷Langer (1997) explores some of this potential.

²⁸Calvin (1996) and Jaynes (1977) discuss the evolution of the structure of the brain. Miller (1995) discusses our place as one of many interdependent living systems.

²⁹Schank (1986) explores many aspects of artificial intelligence as it relates to human intelligence. Schlagel (1999) points out the limitations of artificial intelligence related to machines' lack of living systems. Sutherland (1992) pushes us beyond simply considering

Piaget as the source of biological stage theory of learning. Kegan (1994) proposes that the increase in the complexity of modern life creates more stress on the human beings attempting to decipher that life. Kozulin (1990) explores the evolution of Vygotsky's thought in relation to his personal history. Rowntree (1995) explores alternative ways to present curricula to support and develop student autonomy. Ratner's (1939) compendium of Dewey's writing allows us to see the development of Dewey's ideas, always in the direction of the importance of human relations.

³⁰Hernstein & Murray (1994), more of the same from this team who would like us to believe that we are as little as we fear.

³¹Arendt (1978 a, b) is always asking us to consider who a person is in relation to the choices they make as active participants in an always politicized world. Cassirer (1955 a,b, 1957, 1996) explores the foundations of our thought . Cissna (1988) explores the continuity between Buber's and Rogers' thought as it seems to lead to post modern considerations of the importance of relations to the creation of reality.

³²Argyris (1980) here is eloquent in his defense of exploring a qualitative inquiry to get at more reliable data when studying human organizations and systems.

³³Mink (1993 a, b) delineates concepts for the learning organization that are not noticeably employed by his employer, the University of Texas. Nussbaum (1997) discusses the various types of ethically embedded courses she has studied across the United States.

³⁴Evans & Hill (1986), Foster (1983), Race (1993), Ramaswamy (1999), Shotter (1993), Resnick (1991), Holland (1990), Gattoker (1994), and Rothschild (1982) explore postmodern ethical considerations.

³⁵Kant (1781) begins a long thread of exploration of this theme in modern philosophy.

³⁶Holt (1964, 1967) laid the foundations for an exploration of this theme in American educational parlance. Baecker (1995) compiles many studies which reflect the technological extension of these truths.

³⁷Mink lectures (1999) have explored the correlation between intimacy, trust and work.

³⁸ Apple (1979, 1982) and the critical pedagogists are the most coherent explicators of this social change position.

³⁹ Miller (1995), Andersen (1949), Andriessen (1999), Schank (1986), Beveridge (1989), Bostrom (1992), Cissna (1998), and Billet (1996) all recognize the importance of recognizing the interrelationship of human, living (and mechanical) systems.

⁴⁰ Gersie (1990) explores the power for healing relationships that lies in the way both personal and shared narratives are constructed.

⁴¹ Holt (1964, 1967) expounds on the naturalness of learning and how schools and education generally get in the way of this natural, healthy phenomenon.

⁴² Schank (1986) explores the limitations of closed minds with great humor and efficacy in his early work in artificial intelligence. Williamson (1998) shows how learning can take place randomly. Andersen (1999) also explores some of the ramifications of random interactions.

⁴³ Rogers (1967) and Maslow (1971) revolutionized our conceptions of what we might be able to achieve as individuals in terms of personal fulfillment and positive impacts of relationships.

⁴⁴ Gersie (1990, 1997) explores how our myths of self help us to define our boundaries as individuals.

⁴⁵ Perkins (1995) and Papanek (1992) explore the potentials of going beyond traditional problem solving models. Gelenter (1968) is building artificial intelligence models based on the problem solving paradigm.

⁴⁶ Illich (1971) argues that we are addicted to an educational system that disempowers us and makes us ill.

⁴⁷ Vygotsky's (1962) theory is here the most concisely described.

⁴⁸ Gagne (1977), Biswas (1997), Briggs (1991), Chan (1997), and Damon (1991) explore various ways to design learning systems.

⁴⁹Thiggs (1991), Charlet (1993), Guida & Zarella (1993), Muser (1993), Reynard (1993), Simmons (1993), and Velde (1997) describe artificial intelligence projects based essentially on a problem solving model.

⁵⁰Tzasfestas (1993), Stickler (1993), Steels (1993), Simmons (1993), Rackowsky (1991), and Tsasfestas (1991) describe artificial intelligence projects that attempt to structure the internal logic according to a higher functioning model than problem solving.

⁵¹Goldstein (1997), Rush (1957), Schlagel (1999), Smith (1999), and Mount (1982) describe various methods that have been used in society to elicit and maintain intimacy in human relations.

⁵²Gagne (1977) and Gibson (1975) cover the extremes of learning methodologies; from highly controlled information systems management, to the passion of the quest for knowledge.

⁵³Goleman's (1995) and Gardner's (1983) theories could be used to give teachers more latitude with their teaching styles as well as the way these theories are currently being used to justify students being allowed various pathways to learning. Nyberg (1975) explores some of the reasons open learning might be the wave of the future, it's efficacy as a method for student autonomy. Roth (1981) explores options we have created so far to help us evaluate learning programs. Orwell (1949) describes what might happen should we go fully to the direction of computer delivered, systems dominated learning.

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It reviews various constructivist views of learning and also constructivist technology-mediated learning. It proposes an approach to design and evaluation of constructivist educational software, which is based on research in students' ideas, and comprises three stages: a) initial research into students' existing ideas, conceptions, conceptual difficulties and needs, b) design of the software based on students' conceptions and conceptual needs, and formative evaluation of it, and c) software implementation and evaluation within a constructivist learning. The process of knowledge construction would require specific instructional goals of the learning tasks, for which properly developed cognitive schemata have been developed. Vygotskian theory was built upon the Piagetian idea of the child as an active learner (Piaget, 1959) but with the emphasis on the role of social interaction in learning and development. However, Vygotsky emphasised that children and adults are both active agents in the process of the child's development. "Development is, in this case, co-constructed." (Cole & Cole, 2001, p.37). For teaching it means that both the teacher and a student are seen as active agents in children's learning. The teacher's intervention in children's learning is necessary, but it is the quality of the teacher-learner interaction that is important. Review of Constructivism and Social Constructivism. Roya Jafari Amineh. 1* as a process of construction in which the knower participates. A constructivist teacher's perception of expertise in the classroom is based on the experience of his or her students in interaction with each other and with their teacher, and his or her tolerance of ambiguity is high as evidenced in the tendency to create complexity. Lester and Onore (1990) indicate that teachers' personal beliefs about teaching (their construct systems) are important and determine the kinds and extents of changes they are able to make. Also Lester and Onore state that teachers view teaching and the situation through a constructivist lens. Constructivism, a fifth style of designing language interventions, is best known in South Africa for work undertaken on a large scale applied linguistic investigation, the Threshold Project (Macdonald and Burroughs 1991), that examined the conditions for successful initial literacy, and for switching at some stage to English as the medium of instruction in schools. Constructivism justified the design point that learners grow and develop their language in interaction with others. As we shall note below, this was not the last design phase within applied linguistics to emphasize interactive conditions for learning language. Current constructivists' pedagogies draw on the writings of early 20th century Russian psychologist Vygotsky and the American philosopher/psychologist Dewey. This occurs without examining the historical spaces of the past and present in which that knowledge is socially constructed. This emptying of history in systems of knowledge is odd for an intellectual project concerned with cultural-historical theories. To address this omission, the writings of Dewey and Vygotsky are examined as part of the turn-of-the-century human sciences. They functioned to bring the new democratic political rationalities into the governing of individual conduct.