MOVING TOWARDS CONSTRUCTIVIST CLASSROOMS

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INTRODUCTION

Like King Belshazzar in the Book of Daniel, we in the Kingdom of Education have been ‘weighed on the scales’ and found wanting. We too have been grappling and to maintain what we have “established” over the years and are reticent to make any changes. Papert (1993 p. webpage) makes a compelling statement by saying "the goal is to teach in such a way as to produce the most learning for the least teaching". Great gains in problem solving, creative and critical thinking and learning may occur when education becomes learner centered, active, authentic, collaborative and personal; but gain usually comes with a cost. A paradigm shift in the role of the teacher as well as the use of technology in the classroom is required in order to impliment constructivist strategies.

The purpose of this paper is to expound upon the strategies and approaches which can be implemented by teachers when planning for more constructivist opportunities, regardless of the existing barriers. Murphy (1997) quotes E. Von Glaserfeld (1995) when he points out that many of these practices occurred in inspired classrooms before the theory of constructivism was founded.

> “Constructivism does not claim to have made earth-shaking inventions in the area of education; it merely claims to provide a solid conceptual basis for some of the things that, until now, inspired teachers had to do without theoretical foundation.”

Considerations for a Constructivist Teacher

The listless fly on the wall, in the industrious classroom of a constructivist teacher, may require shoes with suction grip to keep from vaulting off the wall and into the swarm of accomplishment and engagement that promises to invigorate its academic senses (Maor, 1999, Murphy, 1997, Boudourides, 1990, Dougiamas,1998, Hanley,1994, Brooks and Brooks). This is in stark contrast to the tiny starched straitjacket, and readily-available ritalin the fly will require in the hushed and restrained

atmosphere of the “listen-to-me-and-learn” classroom down the hall. Strommen & Lincoln (1992 p.468) speak about the traditional learning environment in this way: “Knowledge is presented to (learners) in a linear, didactic manner that differs dramatically from children's previous experience outside the school.....school stikes them as rigid, uninteresting, and ultimately alienating.” Teachers who are experiencing an appetite for developing a constructivist learning environment will need to suffer through the hunger pains while administrators attempt to identify the costs and changes required in order to deliver this all-you-can-learn banquet.

Many academic writers have outlined conditions that must be met in order to create a constructivist learning environment. (Cennamo, Abell & Chung 1996**;** Driscoll,1994; Murphy, 1997; Jonassen 1991). This paper is expanding upon the work of Maor (August 1999), who has identified five key practices that define constructivist learning environments:

- personal constructions of reality
- simulated authentic learning environments,
- multiple representations of data,
- active learning
- collaboration

PERSONAL CONSTRUCTIONS OF REALITY

The philosophy of constructivism is that knowledge results from the constructive activity of each individual, it is not an entity outside of the mind one wishes to acquire(Papert 1999; Jonassen 1991; Cates,Ward &Mitchell, 1993; Boudourides 1998). What each individual constructs within their own mind, is their reality. Knowledge comes from the creation of meaning that occurs as a result of life experiences. Knowledge does not come from someone else, but rather from experience. For the purposes of this paper, this philosophy is recognized only in so far as it determines practical teaching strategies and learning opportunities where learners

internalize new experiences and knowledge into their existing schema. "Constructivist teaching practices....help learners to internalize and reshape, or transform new information"(Brooks & Brooks, 1993, p. 15).

Authentic Learning Environments

Authentic learning environments occur when instruction is designed to facilitate, simulate and recreate real-life complexities and occurrences. (Strommen & Bruce, 1992; Resnick, 1987; Murphy, 1989; Honebein, Duffy & Fishman, 1993; Strommen & Lincoln, 1992; O'Donnell, 1997;Wolmarans, 2000; Henriette, 2000; Jonassen, 1995; David Brown,1996). To truly capitalize upon complexities one must be willing to invite disorder, disarray, dishevelment and irregularity into our institutions. Constructivist classrooms will reverberate with the movement and sound of "building". This may disturb many regular classroom teachers, administrators, parents and even some students. We have treasured quiet, order and adherence for so long that we have begun to measure learning by the existence of it in our schools. Petraglia (1998) contends that sometimes preauthentication occurs whereby learning materials and the environment are "fixed' by the taskmaster before learner interaction occurs. Often this is to keep the student from "failing", or to save time. Learners and educators alike must recognize that there are great lessons to be learned through failure.

"Trustworthy" is a synonym for authentic. Can we as educators lay claim to providing learning situations that will be "trustworthy" for the learner in good times and bad, so that the learner will not need to divorce their educational experience with the real-life situations they will encounter in the days and years ahead of them? Resnick (1987) suggests that schools should be simulating more of the productive learning that occurs out-of-school in order to prepare students for successful performance in unpredictable and unforeseen situations.

Authentic learning is concerned with depth of learning rather than the breadth of information sucked in and then spewed out; where memorization is misdiagnosed as

being well-informed. Authentic learning environments provide children with rich experiences and opportunities to construct knowledge in context, and in ways that make sense to their existing knowledge which is based on prior experiences (Cox-Petersen & Olson ,2000). Reeves (1997) speaks about the importance of contextual learning in order for students to make connections between the problem and the solution. In order for contextual learning to occur, these students will still find it necessary to acquire factual knowledge, the difference is in the method of acquisition. They will ascertain this knowledge through their own experiences rather than as second-hand donations.

Authentic learning experiences were more common in the past through apprenticeship “schooling” which was highly concrete and had great experiential value. As the schooling system changed to accommodate the Industrial Revolution, the learning became much more abstract utilizing mainly discussion, lectures, and paper and pen tasks. This has become the accepted method of educating our learners, and is criticized because the abstractedness detracts from the experiential experience.(Brown, Collins, and Duguid, 1994). For example, Brown, Collins & Duguid (1994) describe a study on the acquisition of language by Miller and Gildea in order to make a point about contextual and authentic learning. It was found that one year old children learn vocabulary in context at a rate of 5,000 words per year in comparison to 100 - 200 words per year, in classrooms. Obviously another factor of the study is that younger children are just beginning to build their vocabularies so the rate of increase is more dramatic than it is for school-age children. Reeves (1997) advocates that for higher level learning, abstract strategies are inappropriate: “(Other) knowledge is so tenuous, creative, or of a higher level (e.g., mental models) that direct instruction is inappropriate. In the latter cases, CBE programs that promote inductive learning such as microworlds (Rieber, 1992), virtual reality simulations (Henderson, 1991), and learning environments (Hannafin, 1992) are much more appropriate. “ (webpage)

MULTIPLE PERSPECTIVES

A classroom committed to constructivist practices would not promote solely sequential, linear-based, didactic assignments or techniques. (Niederhauser, Salem & Fields 1999, Petraglia, 1998). The teacher would not be seen as “the knower”, but would depend upon a resource-based approach where students would generate their own investigations which would require access to varied and large amounts of current and static data. As students become more adept at gathering their own resource information, they must understand the importance of evaluating data for gender, racial, religious or political biases as well as authenticity, trustworthiness and credibility.

A constructivist teacher would recognize that learners need to encounter the same concept in a variety of ways and situations with varying goals and expectations in order for the learner to become competent in the generation of, and transfer of constructed and contextual knowledge (Cennamo, Abell & Chung 1996, Henriette, 2000, Reeves, 1998, ODonnell 1997,Jonassen et al, 1995, Brown, Collins,& Duguid, 1994). The emphasis is on knowledge construction, not reproduction; the composition of information rather than the imposition of knowledge; multiple outlooks rather than multiple workbooks. The teacher must prepare with imaginative foresight, and imperative insight in order to stimulate and simulate effective encounters that resemble real life education.

Wyld, S. and Eklund, J. (1997). state that:

> “confronting learners with problems from multiple perspectives can promote the applicability of their knowledge across varying situations. Learners have to work with the same concept in different environments at different times and with different goals. So they are expected to develop cognitive flexibility and to generate multiple perspectives of their knowledge. Hypertext systems for example can offer `landscapes' of information which are to be entered and crisscrossed by learners in a random and individual way. “ (webpage pp. 144-164).

Wilson (1995) discusses the notion that learners that are given ample opportunity to "know his/her way around, make connections, vary goals and expectations and competently transfer knowledge to similar contextual situations (they) gain a sense of control, a sense of commitment." (webpage)

Web Quests often offer multiple representations of content. They were initiated in 1995 by Bernie Dodge at San Diego University. Web Quests **(**Donlevy & Donlevy, 2000) are innovative teaching strategies that use the internet to help students become active learners by asking questions, using information effectively and looking critically at data. There are many Web Quests already designed for a variety of topics and issues. There are also templates to download that help educators to create their own.

ACTIVE LEARNING

Active learning inherently implies a "doing". A classroom where the teacher has adopted a constructivist approach to learning expects performance and persistence from the learners. The students are expected and encouraged to generate their own ideas and knowledge by execution, exertion, and expansion of the known. (O'Donnell, 1997;Lunenberg, 1998; Niederhauser, Salem & Fields, 1999; Wolmarans, Henriette, 2000; Murphy, 1997; Wilson, 1997). Learners cannot construct knowledge just by passively receiving, acquiring, or accepting it; nor by inertly listening nor heeding. Knowledge is not formed during the transmission of it. Therefore the emphasis for instruction must be on the creation of meaning and understanding while encountering new information or new contexts. Active learners need to be involved bypartaking, participating, constructing and cooperating. Active learning must happen in order for knowledge to be owned by the learner (Dorit,1999). Jonassen (1996) states that learners must be given opportunities to be active in ways that will promote self-direction, creativity and critical analysis of problems requiring a solution. Brown, Collins and Duguid (1994) affirm that "learning that becomes a continuous, life-long process results from acting in situations."

Wilson (1997), created a list of opportunities for the learners to develop more active constructions of meaning. They included simulations, strategy and role-playing games, toolkits and phenomenaria, multimedia learning environments, intentional learning environments, storytelling structures, case studies, socratic dialogues, coaching and scaffolding, learning by design, learning by teaching, group cooperation, collaborative learning and holistic psychotechnologies.

COLLABORATIVE LEARNING OPPORTUNITIES

The age-old adage of "iron sharpening iron" is indeed true for learners in a variety of guided situations. The natural reaction of mulling over a complex problem or situation with others allows for deeper levels of reasoning, new perspectives, shared responsibilities and greater motivation to remain focused on the task (Rodrigues,2000, Dede,1995 Boudourides, 1998,Petraglia, 1998). A practical implication when conversation and interaction is encouraged rather than discouraged is more noise, less quiet; greater movement, reduced lecturing. When teachers have participated in workshops designed with this style of learning they were more likely to incorporate collaborative work opportunities in their classrooms (Maor,1999 refers to Salomon,1996). Teachers need to recognize collaboration as a viable method of creating individual meaning, rather than viewing it as a means of acquiring information from someone else. Cheating is to defraud, to take; collaborating is to build, cooperate. This action of social negotiation (Vgotzky's) is beneficial and sometimes essential to acquiring specific knowledge.

There is often concern voiced from students, parents and teachers alike about the value or the evaluative problems of collaborative learning in a classroom. Wolmarans (2000) reveals that empirical research indicates co-operative learning promotes higher achievement than competitive and individualistic learning does. Discussions however, continue to occur at a grassroots level concerning who is

learning, and who is getting credit for things they have not learned. Jonassen (URL) states that:

> Groups don't learn, individuals learn. While learners may be part of a group while learning, while learners may learn from one another, and while the social context of a learning environment may provide support for its members; the change in cognitive structure, the acquisition of knowledge and skill is an individual event.

Rogoff (1990) compares collaborative work to that of apprenticeships, where the one who has mastered a skill or concept aids the learner in acquiring similar knowledge. This process of learning is flawed if the “knower” chooses to hand over answers, without effort or exertion (a doing) to create or know, on the part of the apprentice.

Collaborative work allows for classrooms to be more cooperative than competitive. Students begin to view one another as resources rather than sources of ridicule. The social context within which a learner resides is crucial to their achievement. (Salomon, 1998 Petraglia,1998). Strommen & Lincoln 1992 p. found that :

> Constructivism has led to the additional discovery that powerful gains are made when children work together.....children are able to reflect on and elaborate not just their own ideas but those of their peers as well. Children come to view their peers not as competitors but as resources.

To understand a concept to the point of being able to explain it to others, is when real learning has occurred and personal knowledge has been acquired. Lunenberg (1998) believes the value of collaborative learning is in the opportunity for learners to elaborate on their own ideas as well as those of their peers.

Worldwide collaboration is also motivating for both students and teachers as it provides an appealing way for students to gain internet skills while attending to regular classroom activities. (Junion-Metz, 1996). Wolmarans, 2000 refers to the work of, Van

Der Veen and Collis (1997) where some of the problems that have arisen in collaborative virtual learning environments are identified as: course momentum and cohesion, structuring of collaboration and communication, intergroup evaluation, workload of the lecturer.

Klemm & Snell (1996) believe that:

> It is not enough to memorise lecture notes. Students must understand, critically evaluate, and apply instructional materials. One of the best ways for students to develop these skills is to perform tasks that can only be accomplished by these higher-level learning processes. These processes are leveraged if a group works collaboratively to help each other.

Dougiamas (1998) speaks of Vygotsky's "zone of proximal development" which argues that students can, with help from adults or children who are more advanced, master concepts and ideas that they cannot understand on their own. Dougiamas identifies the characteristics of true co-operative learning environments as: positive interdependence, individual accountability, heterogeneous grouping, shared leadership, shared responsibility for others and for self, task and maintenance emphasised, social skills directly taught, lecturer observes and intervenes, and groups processing their own effectiveness.

One of the main criticisms of having students work collaboratively is time effectiveness. Knowledge is increasing, out-of-school activities are increasing and time allotted for specific content is decreasing. The "I-will -tell-you" approach is much quicker than the "go-ahead-and-find-out". Constructivists would argue that since learners must construct their own meaning, the "I-will-tell-you" content will rapidly disappear from the learners databank, making the time spent unproductive and unprofitable at best. A common complaint among parents is concerning the practice of

placing “brighter” students in groups with “slower” students, which then impedes the brighter child’s progress.

Teacher’s Role in a Constructivist Environment

“Many teachers are in favor of adopting constructivist instructional approaches but are unsure of where to begin.” Howard, Bruce (2000)

Since this is the information age, and our society is rapidly becoming knowledge-based, teachers are faced with the dilemma of too much to cover in too little time. In one hand the teacher clutches the curricula, while the other hand grips a well-worn shoe horn; for now teachers are expected to squeeze in content, academic skills, social skills, spiritual considerations, and technological skills. When observing the activities and behaviors of a constructivist teacher on any given day, one would notice the distinctive resemblance to the bounce of a prairie coyote that is warily and shrewdly making its way around its environment in a non-linear, yet purposeful, prepared and productive fashion.

The role of the constructivist teacher is to create a learning environment as invigorating, interactive, immersive and informative as the life of the student outside of the 9:00 - 3:30 time slot Schwartz (1999). If this does not happen, the heated winds of demise will soon be blasting bereavement through the classrooms of Canada. Papert (80’s) in a discussion with Brazilian philosopher Paolo Freire said, “...there's a lot of truth in saying that when you go to school, the trauma is that you must stop learning and you must now accept being taught.” Reeves (1997,) also comments on the roles of teachers as being didactic and well-established. He states: “A quarter century ago, Carroll (1968) told us that ‘By far the largest amount of teaching activity in educational settings involves telling things to students...’ (p. 4). More recent analyses of teaching indicate that little has changed since then (cf., Goodlad, 1984; Kidder, 1989; Perelman, 1992). “

The role of the teacher in a constructivist environment is not just viewed with a different focus, but through a distinctively different lens. The learning that is captured within a constructivist environment is pictured as student centered, collaborative, minds-on, authentic and action packed (Wilson,1995). For some teachers, this rings with the magic of beanstalk growth, while others will be disenchanted with a perceived lesser role of coach, facilitator or guide. Maor (1999) speaks of the implications of studies that have been completed on constructivist-oriented approaches to teaching and learning, that have substantiated the importance of changing the role of the teacher in the learning process. Maor (1999) goes on to say that:

> The teacher becomes the facilitator or coach. He/she does not possess all the knowledge, graciously allowing it to trickle down, to the great fortune of the learner. This may be cause for anxiety for teachers as uncertainty develops and envelops their new role.

Murphy (1997) discusses how important it is for the teacher to utilize errors as a way of providing feedback for the learners' understanding. Petraglia (1998) claims that in a constructivist environment the best hope for the educator is in the possibility of intervening in the learning that is occurring, rather than being in charge of the act of learning. If teachers desire to intervene in the learning game, they must be aware that they are not the one in possession of the puck.

Teachers who are interested in assessing the degree of constructivism used within their classroom would benefit from reading Hanley (1994), who refers to Yager's (1991) checklist. Brooks and Brooks suggest twelve strategies for teachers to exercise in order to move towards a more constructivist approach:

- encourage and accept student autonomy and initiative;
- use raw data and primary sources, along with manipulative, interactive, and physical materials;
- use cognitive terminology such as "classify," "analyze," "predict," and "create" ;

- allow student responses to drive lessons, shift instructional strategies, and alter content;
- inquire about students' understanding of concepts before sharing their own understandings of those concepts;
- encourage students to engage in dialogue, both with the teacher and with one another;
- encourage student inquiry by asking thoughtful, open-ended questions and encouraging students to ask questions of each other;
- seek elaboration of students' initial responses;
- engage students in experiences that might engender contradictions to their initial hypotheses and then encourage discussion;
- allow wait time after posing questions;
- provide time for students to construct relationships and create metaphor;.
- nurture students' natural curiosity through frequent use of the learning cycle model. (The learning cycle model consists of discovery, concept introduction, and concept application);

Constructivist teachers must create opportunities for peer scaffolding and teacher-directed scaffolding which is the process of allowing interaction that stimulates knowledge building, and therefore bridges differences of knowledge levels within a classroom. Traditional teachers are often uncomfortable within this exchange. Sometimes it would seem the only thing that is courageous enough to vigorously be exchanged from student to student within our institutions is head lice. The role of the teacher is no longer to be “the one” but to provide each one with opportunities to learn how to learn,(Jarvinen 1998, Cohen 1993).

Constructivist teachers are often viewed as the “anything goes” type. However, Wilson (1997, webpage) says that:

> Too often, constructivism is equated with low structure and permissiveness-imposing predefined learning goals or a learning method is somehow interfering with students' construction of meaning. In extreme cases, that may be true. Yet to help students become creative, some kind of discipline and structure must be provided.

Wilson (1995, webpage) also says that:

> As the teacher relinquishes control over content, pacing, and specific activities, students need corresponding increases in decision and performance support. Poorly planned learning environments are vulnerable to failure due to lack of support, leaving students feeling stranded and faced with unreasonable performance expectations. This problem is complicated by the fact that learners differ dramatically in their need for support.

Dougiamas (1998) and Papert (1999) see constructivism as teaching with an approach that seeks opportunities for students to analyse, investigate, collaborate, share, build and generate based on what they already know, rather than store away facts, skills, and processes they can later parrot. The use of metaphors during instruction is encouraged. To do this effectively, Dougiamas (1998) and Maor (1999) believe that a teacher needs to be a learner and a researcher. Giving teachers the opportunity to work as a learner, helps them overcome anxieties about novel situations. This provides the impetus for epistemological change within the profession.

Professional Development

Passengers on the Titanic were so convinced of its “unsinkability” that they played with the ice chunks that landed on deck. Traditionalists have also boarded the unsinkable educational ship. Many are blissfully content, under contract, and reticent to contest any professional development that requires more time, effort or learning. (And many definitely don’t want to be forced to actually read). Maor (1999) and Cohen

(1993) speak of the importance of professional development. Maor refers to the work of Loucks-Horsley (1998). who claims:

> when trying to create systematic reform "professional development is one of the critical links in this chain, one that can take purposes and policies and influence student learning through its impact on teaching. To inspire any fundamental change in the classroom, teacher learning is essential.

Howard (2000) and Salomon (1998) believe that in order for professional development to occur, there must be high levels of discussion, peer to peer tutoring and actual learning by doing. Teachers must become team players, flexible and willlling to improve upon their existing skills and knowledge base. Salomon (1998) asserts that training for this must be introduced piece by piece, unobtrusively so as not to upset the status quo. However Papert (1987) asserts, if the new ideas can be smoothly assimilated they will be equally ineffective.

As technology continues to advance the adventuresome teachers will require opportunities to enhance their own skills. Niderhauser, Salem & Fields (1999) claim that a technology course for teachers provides a forum for reflection, a deeper understanding of learning theory, an opportunity to analyze assumptions, critique the nature of school-based learning experiences and examine the relationship between learning theory and instructional practice.

Wyld & Eklund (1997) state that time and money is needed for professional development of teachers in order to allieviate some of the anxiety and fear accompanied by change. Papert (August 1999) proclaims:

> Teachers will have to make a transition and this will have a cost. But this cost should not be attributed to technology; it is the cost of transition to the needs of a future world. Or rather, it is the cost of the failure of our schools of education to anticipate these needs. And this cost grows higher every

> day that schools of education continue to pour out graduates prepared for a bygone world and so in need of costly transition to a new world. (webpage)

If inroads are to occur at the grassroots level, then the administration must be willing to plow the way. Brooks and Brooks suggest that administrative changes need to occur in order for the development of constructivist strategies to be implemented. Three of these suggestions refer to professional development.

- Inservices utilizing constructivist principles and practices.
- The purchase of professional resources should outweigh student resources.
- Annual seminars for all levels of administration.

The results of working collaboratively on complex and authentic problems may not lend itself to meticulous evaluation sheets or intensive testing methods. However, Wilson (1997) believes that evaluation and assessment does not have to shift to the extreme of being totally goal-free and non-committent.

The role then, of the constructivist teacher, is to adhere to the methods of a flexible coach, facilitator, researcher, learner, interior designer (creates the environment), evaluator, professional and team player. Constructivist teachers will need to move from teaching in a one-dimensional, simplistic and flannelgraphed format to a multimediated, complex and learner focused forum.

The Role of Technology in a Constructivist Classroom

“Will current attempts to make our schools the best of their kind only succeed in making them the best of an obsolete kind? “Seymour Papert (Cohen 1993, webpage)

The claim of a recent advertisement (for mattresses) states that ‘technology is no longer a luxury’. People are used to fast paced, multi-sensory, highly interactive comfort and convenience all around them. They are now used to processing and evaluating data in 30 second Mcsegments rather than one hour lectures. In order to capitalize upon “life in the real world”, we must concede that technology in Canadian

classrooms is no longer a luxury. If education is to be pertinent, productive, progressive and proficient then the fever of technology can no longer be starved, but must be fed, embraced and embodied within our institutions; making every attempt to fuel it rather than cool it. Papert (as cited in Bennahum, 1996) believes that computers in the home is ironically the biggest source of change in education. He persuasively argues that for this reason students will be less and less willing to be educated in ways that are inferior to what they can achieve at home with their computer.

Strommen & Lincoln (1992) assert that:

> ...although the schools are embedded in our culture and reflect its values, the technological changes that have swept through society at large have left the educational system largely unchanged. Computers, video and other technologies,...engage children with the immediacy they are used to in their everyday lives. Technology in and of itself cannot be the focus of the changes that are needed in American education. ...what is needed is a wholesale revision of educational practice that focuses on children's own competencies.

Constructivists do believe there is a place for practice and drill. They recognize the fact that learners require opportunities to assimilate new information in repetitive and multiple ways. Petraglia (1998) asserts that computers can serve as coaches by locating the problem and allowing for as much rehearsal, practice and help as necessary to accomplish the task.

Jonassen & Reeves (1996) determined that the use of computers can enhance cognitive powers of students during thinking, problem solving and learning. As North Americans we are inundated with technology pervading every aspect our lives. Yet within educational institutions, the amount, quality and expertise in technology is grossly insufficient. Jones (1997) refers to work by Jonassen (1988) who speculated that the power of the computer would one day match the power of the human mind. Jonassen

asserted that learners would be able to act and learn in an environment that would provide them with the choices, tools, and constructs to help them learn, and not merely instruct them. Can children learn without technology? Certainly, but whether they can then survive in a technological climate without experiencing tsunami effects is yet to be discovered. If we are recklessly teaching our students only how to operate computers oblivious to our approach to learning and teaching with computers, then we are sending them out for a sluggish Sunday drive on the frenzied Information Freeway; this is sure to end up with disastrous results.

Schools, devoid of technological connection due to financial restraints or a lack of knowledgable educators, should be sending out an alarm proportionate to that of the disconnected Mir Space Station. When our students are not "connected" to technological processes and are out of touch with the global village, the results will be long term diminishing economic value, political ambivalence and social disfunctions. Murphy (1997) declared that: "Technology is increasingly being touted as an optimal medium for the application of constructivist principles to learning. Numerous online environments and technology-based projects are showing that theory can effectively guide educational practice."

Software, even objectivist software, can be used in constructivist ways whereby students can design and create artwork, explore simulations, problem solve in multimedia presentations, experiment in virtual worlds, participate in musical creations, investigate web sites, or robotic constructions. These complex, collaborative and authentic projects will challenge the ways in which students learn and understand. These types of activities will maximize their learning opportunities rather than minimize the mind by copying information onto word processors.

Historic events define the fabric of all communities, virtual and terrestrial. Definitive learning environments of home schooling, apprenticeship and institutional forums have long been seen as signposts along the timeline of humanity

(Salomon,1998). We have educated our youth at home through the great depression, in silence during the haulocaust, in anticipation during the space age and in exhasperation during this, the RAGE AGE. People are unexplainably becoming enraged in a variety of situations. The media is flooding us with stories of air rage, sports rage, fan rage and road rage. What has yet to be identified in our schools today is simply RetroRage. Students are being kept in a system that is retroactive, retrograded and retrospective. We are continuing to educate students in ways that are deteriorating, degenerating and devoid of real life influences (Lunenberg, 1998). Papert (1996, webpage) claims:

> It is 100 years since John Dewey began arguing for the kind of change that would move schools away from authoritarian classrooms with abstract notions to environments in which learning is achieved through experimentation, practice and exposure to the real world. I, for one, believe the computer makes Dewey's vision far more accessible epistemologically. It also makes it politically more likely to happen, for where Dewey had nothing but philosophical arguments, the present day movement for change has an army of agents. The ultimate pressure for the change will be child power.

Allesi (S.C.G.) states that:

> technology can be a savior or a destroyer. It might even be a great equalizer, since people who can read cease to have any advantage over people who can't. But it might also be a destroyer of culture and of our cognitive abilities."

Computer tasks of reading, writing, communicating, researching, problem-solving are all embedded in technology.(Dougiamas ,1998, Halpin,1999, Cohen, 1993). Students should utilize technology as a mode of learning, rather than as a tool within the existing system. Technology is capable of changing the educational signpost at the

gateway to the future. It can create learning environments that are authentic, challenging, interactive, and immersive.

Technology can serves a variety of purposes. It can make use of anchored instruction (Muller, 1992). Narrative anchors assist the learner in attempting to solve complex problems with realistic videodiscs. The videodiscs contain necessary information for solving the problem. Learners must determine the relevant information and develop strategies for understanding and then solving the problem. Rodrigues (2000) states constructivist research findings in terms of context, relatedness and active, minds-on engagement in the learning process have yet to be fully interpreted and translated into software design. Brown (1996) found that the use of computers as workbooks is not compatible with constructivist thinking because children are not allowed to manipulate and change the information, but simply have to choose the right answer.

The most appealing aspect of accessing information through the WWW is that it is presented in a range of multimedia styles, such as text, graphics, sound and video, making the world wide web very popular with students of all ages, at least until the novelty effect begins to wear thin (Junion-Metz, 1996). Browsing and selecting appropriate information on the internet requires students to acquire research skills and discernment between authors and website designers. Wolmarans (2000) refers to work by Reeves (1992) that states that knowledge that is merely presented without learner interaction is effective in acquiring procedural knowledge and some conceptual framework, but a truly engaged learner is a motivated learner. Wolmarans (2000) refers to Fleming & Levie (1993) who declared that general intrinsic motivational principles come from variation, curiosity, relevance and challenge. She further points to Malone's (1981) work where it was found that "one of the powers of interactive electronic instruction is the capability to engage by providing rapid, compelling interaction and feedback to the student" (Wolmarans, 2000). .

Wyld & Ecklund (1997) found that:

> Despite the small amount of experience that schools have had with the Internet, there is almost universal enthusiasm about the potential of the Internet in education It is these teachers who have persevered through many self-dedicated hours, to gain an understanding of this technology and learn how to integrate it into the classroom. It is also these teachers who have had a desire to share their experiences and their learning curves. (webpage)

Wilson (1995) believes that all learning environments, traditional and constructivist, include information banks, symbol pads, phenomenaria, construction kits, and task managers. He further asserts that a *minimalist* environment emphasizes the information banks, symbol pads, and task masters. This creates few opportunities for manipulating and observing content, so problem solving and learning through exploration is minimal. A *richer* environment contains the phenomenaria and construction kits where the learners are encouraged to be more in control of their own learning.

Wilson (1995) defines three types of learning environments that involve technology in varying degrees. C*omputer microworlds* are closed, self-contained systems, that may or may not exist within a larger classroom environment. Learners interact mainly with the computer system, this may be effective for home-schoolers, and multi-grade classrooms. *Classroom-based learning environments* are where various technologies function as tools to support the learning environment. Wilson sites Vanderbilt's anchored instruction as an example of this. V*irtual environments* are mainly open systems that allow for interaction among other participants, resources and representations available virtually.

Papert (1988) established some important guidelines for the placement and use of computers in schools.

1. Seek out open-ended projects that foster students' involvement with a variety of materials, treating computers as just one more material, alongside rulers, wire, paper, sand, and so forth.

2. Encourage activities in which students use computers to solve real problems.

3. Connect the work done on the computer with what goes on during the rest of the school day, and also with the students' interests outside of school.

4. Recognize the unique qualities of computers, taking advantage of their precision, adaptability, extensibility, and ability to mirror individual students' ideas and constructions of reality.

5. Take advantage of such new, low-cost technological advances as temperature and light sensors, which promote integration of the computer with aspects of the students' physical environment. (webpage)

Papert states: "Better learning will not come from finding better ways for the teacher to instruct, but from giving the learner better opportunities to construct." Cohen (1993). It may hinder the very process of constructivism if technology is used in precisely the same format as the existing tools we now have.

Constructivism also has some strong adversaries. O'Donnell (2000) speaks of his concern that not all learners would benefit from having almost unlimited control over their own learning. He contends that many of the problems of American schools are being blamed on Instructional Designers' when schools rarely use what is known about Instructional Design. As well, O'Donnell (2000) believes that goal formation is not likely to occur if complexity is excessive, and the use of complexity is one of the cornerpegs of constructivism.

Rodrigues (2000) refers to the fact that much of the current software is marketed as constructivist, primarily because access to information is nonlinear. This one aspect is not what makes software constructivist, but it may be what is currently marketable.

Instructional systems designed with open access are often considered constructivist simply because the user's pathway is determined by the user and not the designer.

Further points against the implimentation of constructivist methods are that it is time-intensive; difficult to create collaborative groups that can effectively work together; difficult to design instruction to accomodate the prior knowledge of each individual student within a classroom; and difficult to keep up with the amount of evaluation tha is required. It becomes so demanding that peer-assessment and self-assessment must also be incorporated, creating further problems at times. Financial concerns may outweigh all of the above. Creating learning environments that are authentic and real-life is expensive as well as time consuming. This change of current learning environments, professional development and technological advancements carries enormous financial obligations with it. Educational technologists may have solutions to all of these dilemmas but since the necessary technology itself is slow in appearing on the horizon of the classroom, we can anticipate the changes to be slowly incorporated over long periods of time.

SUMMARY

It is interesting that since the deinstitutionalization intellectually challenged individuals, the "educational" standards and methods for educating them have much more reflected constructivist approaches than any other segment of education, apart from apprenticeship training. These individuals have often been taught life-skills in contextual settings; have learned within simulated authentic learning environments, worked within the community, and have attacked the same problem (such as identifying washrooms) from a variety of representations. It would be a rare situation for these individuals to be educated in non-verbal classrooms with little chance for movement, exploration, scaffolding or collaboration. The segregation of these individuals in the past has had many negative consequences, but possibly, their way of constructing, their way of learning, has been strengthened. Perhaps similar strategies would be of benefit

to the entire student body. Regardless of the philosophy or theories attached to specific teaching methods, all educators should strive towards building educational opportunities that are authentic and challenging, where students are actively involved and allowed at times to collaborate. And finally, educators should design their instructional methods in ways that allow for multiple perspectives of targeted concepts to occur.

Change is inevitable. Educators, like the guard of the Brinks armored car, must keep a vigilant eye on their own perceptions towards inevitable changes. They must guard against the mindset that technology is out to replace teachers and their roles in education. They must guard against methods and practices that pose as learning opportunities, but truly only mark the passage of time. They must also struggle to guard the accomplishments of the past and shield future generations from educational apathy and latency. Most of all educators must stand against change for the sake of change.

RELATED WEBLINKS

These websites describe and/or illustrate **constructivist designs** that have occurred in a variety of educational situations. The parameters of the learning and the results of the projects are fully disclosed and discussed online:

- Using Technology to Provide Authentic Learning Experiences for Preservice Teachers. **...** Project KITES, Kids Interacting with Technology and Education **...**
www.coe.uh.edu/insite/elec_pub/html1995/0817.htm
- Lebow, DG (1994). Authentic activity as a model for appropriate learning activity:
Implications for **...** tool for reconnecting kids with society. Interactive **...**
www5.compaq.com/education/k12/resources/authentic2.html
- Authentic learning activities involve students in social and **...** demonstrated by the
popular National Geographic Kids Network, in which students conduct **...**
udel.edu/~jconway/authlrn.htm - 13k

- Traditional mathematics has been an obstacle to kids being able to work with data,"

... the new standards are calling for more authentic learning.". **...**

www.edweek.org/sreports/tc98/cs/cs4.htm - 19k

- There are many websites that promote authentic learning. This claims to be immersive, interactive and authentic. www.eduweb.com/adventure.html.

Technology Horizons in Education Journal: T.H.E. Journal offers articles on the uses and integration of a variety of technologies in the classroom.

CALICO: Computer Assisted Language Instruction Consortium is another great resource dedicated to the exploration of the new technologies as applied to language learning.

Teaching with the Web: a compilation of ideas for using WWW resources as a language teaching tool. It also offers links to collaborative learning projects, pedagogical information, publications, and organizations.

Instructional Design in Distance Education: an annotated list of links to resources on teaching in a distance environment.

www.eduweb.com/adventure.html: a compilation of a variety of adventures that are interactive, indepth and immersive.

Kids Web

http://www.npac.syr.edu/textbook/kidsweb/

This page is designed to provide links to students in content specific areas

Virtual Schoolhouse

http://sunsite.unc.edu/cisco/schoolhouse

Referenced in our power point presentation

Kidopedia

http://rdz.stjohns.edu/kidopedia/

An encyclopedia written by kids

The virtual reference desk

http://thorplus.lib.purdue.edu/reference/index.html

Just about every reference material imaginable

Exploratorium

http://www.exploratorium.edu/

Online science museum

The Internet Public Library

http://ipl.sils.umich.edu

A guide to reference sources and school subjects

Smithsonian Institute

http://www.si.edu

Reference for all Smithsonian museums in Washington, D.C.

Kids Place

http://www.cas.psu.edu/docs/pde/kidsplac.html

A link to many cool sites for kids.

Math/Science

Math Magic

http://forum.swarthmore.edu/mathmagic/index.html

Math brainteasers

Whale Watching Web

http://www.physics.helsinki.fi/whale/

Place to see and hear whale

Discovery Channel Online

http://www.discovery.com/DCO/doc/1012/online.html

Online version of cable t.v. science channel

JASON Project

http://seawifs.gsfc.nasa.gov/scripts/JASON.html Live scientific expeditions

NASA Shuttle Web http://shuttle.nasa.gov/

Space shuttles

Welcome to the Planets

http://pds.jpl.nasa.gov/planets/

Space information

Social Studies/History

National Museum of the American Indian

http://www.si.edu/organiza/museums/amerind/start.htm

Exhibits about Native Americans

American Historical Documents

gopher://wiretap.spies.com/11/Gov/US-History

Text only - American historical documents

Project Vote Smart

http://www.vote-smart.org/

Complete source of U.S. political information

Thomas

http://thomas.loc.gov/

Source of Congressional information

Finding Your Way with a Map and Compass

http://info.er.usgs.gov/fact-sheets/finding-your-way/finding-your-way.html

Learn to read topographic maps

Reading/Writing

Ink Spot

http://www.inkspot.com

List of help sources for young writers

Book Wire

http://www.bookwire.com

List of book sites on the Internet

On-line Book Reviews

http://www.worldreading.org

Recommendations by kids for kids

The Realist Wonder Society

http://www.wondersociety.com

Poetic myths and fairy tales are posted at this site

CyberKids Magazine

http://www.mtlake.com/cyberkids/

On-line magazine for kids

Scholastic Central

http://scholastic.com

On-line site of Scholastic

Teacher Sites

Marco Polo

http://www.mci.com/marcopolo

Activities for teachers to use with kids

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