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This Journal was established to facilitate collaboration and communication among researchers, innovators, practitioners, and administrators of education and training programs involving technology and distance learning.

An academic institution, Duquesne University, was chosen for its commitment to academic excellence and exemplary programs in instructional technology and distance learning. Duquesne University is supporting the Journal through its graduate program in Instructional Technology and its Center for Technology Education Innovation and Research (TEIR Center). In addition to its educational programs, Duquesne University has major training contracts for industry and government.

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Table of Contents – July 2004

Page

Editorial: **1**

Donald G. Perrin

INVITED PAPER

No Two Swimmers Float Alike **3**

Guy Bensusan

REFEREED PAPERS

On Shifting Sands:
Exploring the Curriculum and Assessment Dichotomy **11**

Lebusa A. Monyooe

Reusable Learning Objects Aggregation for e-Learning Courseware Development at the University of Mauritius **27**

Mohammad I. Santally, Mahen Govinda, and Alain Senteni

RecoSearch: A Model for Collaboratively Filtering Java Learning Objects **35**

Jinan Fiaidhi

CS Teaching and its Impact on the Booming of the Software Industry **51**

Najib A. Kofahi and N. Srinivas

STUDENT PAPER

Student Self Efficacy and the Distance Learning Experience **61**

John DeCarlo

Editorial:
It's All About Learning

Donald G. Perrin

I watched my friend teach his lesson. It was a brilliant exposition that brought expressions of wonder and excitement from every member of the audience. I was impressed. I began to wonder what I could do with what I just learned. It had no relevance to me. And I realized it probably had no value to his audience. It was a brilliant exposition that was hollow, irrelevant, without value. He missed his calling. He should have been a magician or a politician.

I thought back to a personal exchange with Dr. Edward Deming, the man who brought quality to Japanese automobile manufacturers. I was one of the fortunates to hear him speak at a meeting about *quality*. I asked if awards for teaching excellence made a difference. He exploded and stood up in his wheelchair. "Such awards are ridiculous." he said. "Popularity contests maybe. You don't know their real value for another five years." That made sense. If you could survey students five years later, and they could tell you how much and how often that learning was used.

Deming's points kept echoing in my mind. "Data! Data! Data! To make good decisions you need lots of reliable data." How often have I arrived at an answer before the question was finished? You need relevant data and a thoughtful analysis to make a meaningful response.

My mind began musing on the art and science of teaching. I thumbed though my desk copy of Bruce Joyce's *Models of Teaching*, 7th edition. This is a standard text for teacher education that is truly excellent. Are these models easily adapted to distance learning? Can I combine these models with Curtis Bonk's interactive media for teaching and learning?

Do we really have a science of learning? We determine needs with assessment tools, specify outcomes with behavioral objectives, describe levels and domains of learning with Bloom's Taxonomy, select content, media and learning environments based on somebody's theory of instructional design, plan lessons with Gagne's nine events of instruction, design and produce evaluation instruments, develop, test and revise prototype lessons, then produce, implement and evaluate the real lesson. If we are working with learning objects, we integrate and customize pre-tested modules to achieve the same result in a fraction of the amount of time.

Add the distillation of 100 years of psychological literature, philosophies of learning, learning styles, and instructional technologies, and . . . . Do we really practice what we know? Or are we like doctors who, after 20 years of school and college, prescribe the same six drugs for most of our "patients".

I am impressed by national efforts to update curricula and improve teaching and learning. In fifty years I have seen a profusion of ideas come and go. Attempts to classify and organize content were put aside for a *standards based curriculum* (Compendium of Standards and Benchmarks for K-12 education). Computers play a growing role in diagnostics, prescription, production, storage and retrieval, presentation, interaction, evaluation, and management of learning. National libraries of earning objects provide instructional components that can be assembled by a computer to match a computer diagnosis and prescription.

I have followed instructional innovations for half a century. Next month I go to Australia where they make effective use of ideas we abandoned to explore for the next "latest and greatest" innovation. Educators and trainers have many wonderful tools at their disposal, and a morgue of great ideas partially developed. *We know much better than we do* . . . .

INVITED PAPER

Invited Papers feature leaders in Instructional Technology and Distance Learning.

The late **Guy Bensusan** broke the traditional mold for teaching and learning in his television courses for Northern Arizona University. Subsequently, he adapted and applied interactive learning techniques to courses on the World Wide Web. Through command of subject matter and sensitivity to individual student needs, he developed a highly successful paradigm for peer learning.

Dr. Bensusan's philosophy and practice grew with advent of new technology and acceptance of distance learning as a viable and effective alternative to traditional methods of teaching. He is the master teacher, leading us into new paradigms of teaching and learning. Through his writings he takes us on a journey of exploration and discussion. He shows us how to motivate students and achieve results with anywhere-anytime collaborative learning that are the envy of most classroom teachers. The Bensusan Method continues to enrich the lives and learning of tens of thousands of students every year.

No Two Swimmers Float Alike describes how, through discovery and experimentation, he developed ways to deal with individual differences and enhance learning and performance. He describes parallel approaches in education and training as he adapts each learning principle to an academic environment.

The Publisher and Editors of this Journal are grateful to the Bensusan Foundation for permission to reprint this milestone article.

No Two Swimmers Float Alike

Guy Bensusan

Driving home from college one day in 1949, I saw a new outdoor Swim School preparing to open. At seventeen and, I thought, a terrific swimmer, fantasies danced in my head about having a job as a swimming instructor, lounging around a pool in-between lessons, getting a tan and a salary at the same time. I went in to inquire about a job, only to feel my knees quake at the sight of the manager behind the counter. She was a young, bronzed blonde in a white bathing suit, her long braids down to her waist. She looked me in the eye and asked if I would swim for an audition. Dreams of being the tanned coach, drying my wavy hair with a snow-white towel vanished – suddenly I was again the student, obliged to do as the teacher told me.

She saw potential in me, and for the next eight weeks coached me daily on strokes, style and body position. She helped me understand self-control over breathing in the water, guiding in many ways as she helped me learn to teach. Gentle and patient, she always encouraged me with positive words to do more and go farther. In the subsequent five years I worked with her, I never saw her be unkind or negatively critical of anyone. When I entered graduate college at UCLA, she provided a fine recommendation for another job at a pool nearer my classes.

There I taught students ranging from age one to eighty-five. Most of the day I spent in private and semi-private lessons, where I was in the water one-on-one for fifteen minutes per client, or thirty minutes with two or three persons. It was highly individualized, talking with each one, making suggestions about head and body position, and getting each to keep experimenting with reorienting themselves in the water – a situation where they were horizontal rather than vertical, and where their sense of direction was altered. In those lessons my job was primarily to help adults discover swimming effectiveness for themselves, building first on their individual strengths, comfort zones and confidence.

It was different in the late afternoon, when the pool filled up with classes of cub scouts and campfire girls in groups of ten. Teaching those kids was not the same, I was told, because they were absolute beginners. I had to get them over three big hurdles: (l) getting their faces in the water and opening their eyes, (2) lying down in a face-down horizontal float and standing up again, and (3) learning to coordinate rhythmic breathing with their arm strokes. (Interestingly enough, adults who were beginners had to overcome the same three hurdles – but we did not treat them the way we treated the kids!)

A long-standing convention in teaching these three beginning skills existed; teachers stood on the deck and gave verbal instructions, never getting into the water with the students; each group of ten in the water was lined up along the wall, and were told to put their faces in, blow bubbles, hang onto the side and kick, kick, kick; then they were told to float face-down, add kicking, then the arm strokes, fit in the breathing, and finally swim across the pool: all standard stuff.

The formula was in the Red Cross Teaching Manual; it was traditional, tried, true, official and unchanged for years. Teacher was a drill sergeant – barking orders by the numbers and sending the kids out in successive platoons. Absolute equality prevailed; each kid was treated just like the next, with no room for individuality. If someone was timid and missed a turn, too bad. Maybe next time. I remember thinking that if this was all that was involved in earning a living by teaching, my life would be a breeze – all I needed was a whistle.

I also remember noticing that this type of teaching corresponded more to the way in which my university classes were conducted rather than to the individual and semi-private swimming sessions I taught. I didn't like the usual militaristic manner of teaching at the swimming pool – yet was the teaching done by my University professors any different? The instructors, standing up at the podium, lectured with wit and brilliance; they analyzed, classified, defined, compared and compartmentalized – and I dutifully wrote it all down, paddling along with the rest in unison-response as best I could, hesitant to ask too many questions when things were not clear – since I believed that the teacher knew all and the student was a dummy.

As a university student, I was expected to perform in like manner with all the other class members, just as the group-swimmers were all expected to progress in identical, proper styles of keeping up in the water, getting to the mark, so to speak, in a manner easily measurable by the teacher. I thought the Red Cross method was so impersonal, producing considerable pressure and anxiety amongst the children. It caged learners into sequenced regimentation without giving attention to the obvious fact that each had his or her own "learning metabolism."

It forced all into the same mold rather than allowing each to develop first in the most comfortable manner, after which other strokes could easily be added. It underplayed or ignored the factor of individual "fear." Many kids were confused by mixed messages: "stay away from the water or you'll drown." Many were afraid of the water. Mothers urged them to swim, but it was common for them to be petrified, rigid with panic. I could not really help them until they relaxed and loosened up.

Vocabulary was also a problem; it was imprecise and confusing, something I probably noticed because of the cognitive university training in specific definitions I was getting. For instance, the word "UP," staying UP in the water, and turning the head UP to get a breath was confusing and counterproductive. One doesn't try to stay UP – one lies right IN it, as in a feather bed: the water supports the floater. To get air one only needs to ROLL OVER in the floating position. In other words, one does not "come up for air," but rather rotates in the horizontal plane so that the back of the head is in the water and the mouth is out. Using the proper words made a difference in the instruction!

The same was true at the university; the vocabulary professors used differed from one discipline to another – repatriation in political science did not mean the same as it did in anthropology. Strict, uncompromising instructions concerning examinations affected the ease of my breathing: so did the obvious assumption that we students would all cheat if we could figure out how to get away with it! I recall the intimidation when the professor announced we must know all 400 slides by date, artist, style and current location! And my term papers had to contain a specific number of pages with a given number of footnotes and bibliography items if I didn't want points deducted!

As semesters went by I began to compare teaching in a pool with teaching in academe. A disturbing contradiction existed; in teaching private lessons to adults, I worked with the students, cooperating with them, finding new ways to enable them to learn how each one could achieve comfort, success and confidence, becoming at ease with their own devices. This eliminated student competition, because no two swimmers learned about water precisely in the same way, in the same sequence or at the same pace; each had a mental or physical method of accomplishing the important end result: i.e. how to swim. And, in my pool experience, all people could float if they would relax and keep air in their lungs. They did not need to be taught how to do it, they only needed to be given some assistance in being able to "feel" the minor adjustments they had to make in this novel situation in order to do it best for their particular body type.

It was the opposite at the university; the teacher held the information as well as the academic hypotheses and the pedagogy of how to implant them in us. We, the unknowing students, had to compete with each other, if not for professor-favor, then for the gold-ring of the "A". We competed in writing, tests, and in responding to the professor's factual questions on those limited occasions when we were asked. We also competed to avoid giving the "wrong answer" or bringing up germane points that were outside of the professor's intellectual preference or outlook. As in the group swim-sessions, the timid and non-competitive people simply lost out, becoming overwhelmed by the situation, by the peer pressure, and because they failed to get help or attention from the professor when they did not respond quickly to his verbal pushing. It was sink-or-swim in the classroom!

Paradoxically, in the pool I floated naturally (not intellectually) – I was immersed physically and mentally in a supportive, creative, rewarding and holistic world, both for me and for the pupil who was learning, or rather teaching him/herself a new skill and valuable achievement; as a graduate student, I was engulfed in information, memorization, and regurgitation. The contradiction became a dilemma. I yearned to achieve in university life the same warm feelings of reward, fulfillment, or exhilarating discovery I had experienced in swimming. Instead, I found conflict, tension and anxiety.

Unsophisticated, I questioned my professors about the differences I was experiencing. Many were condescending about it, though some were sympathetic. I remember long talks with some of those superb scholars I still admire. They kindly and patiently informed me that all academic fields are separate unto themselves, that each is a distinctive discipline with its own rules and language. I was encouraged to think of my morning water-world as yet one-more-kingdom, just like geography, history, geology or political science. It was suggested that I not try to integrate one with the other, since they were not inter-changeable.

At the same time, I was not getting support in this matter from my employers at the swimming school; they were highly competent in the water, but were not able to communicate their ideas in words. I might follow their instructions, but I could not get them verbally to articulate the conceptual chasm. Back then, I felt they had let me down, though I now understand I was expecting too much from them, as well as from my university professors, neither of whom were as fortunate as I to be experiencing both worlds simultaneously.

In 1955, therefore, I chose to accept the logic of what the university professors told me, and I deliberately disconnected and separated my world of humanistic interaction in the tactile world of teaching swimming from the factual catechism of those academicians who would award me with my History degree! I did not know it then, but the inconsistencies in those un-parallel experiences would make my professional life uneasy for the next thirty years.

My role as swimming instructor paid for graduate school, and in time I was also employed as a History graduate assistant teaching undergraduate students. The dichotomy thus continued and, as the "expert" who knew historical facts and ideas, I verbally imparted information and concepts while the students functioned as scribes and sponges. Back at the pool, however, I continued providing a safe milieu for experimentation and challenge, with constant feedback to the learner, who was essentially a "discoverer" or self-teacher in the altered environment.

At least this was partly true. There was also a self-contradiction in the swimming pool – private lessons were much different than group classes. The Red Cross system moved large numbers rapidly and mechanically through a series of categorized skills. It was an assembly-line approach and, while costs were lower, the results were not always of the highest quality. All teachers were expected to use the same sequences, but I was bothered by what I saw as a double standard – some were pushed through the regular mill of instructions, while others, who paid more, got "preferred treatment." We catered to two classes of citizens, the patricians who paid well for individualized attention, and the plebeians who flocked to the "low-low price" offered in group lessons. In my idealism I wanted everyone to be a first-class citizen.

Yet at the university, either as teacher or student, our seats were numbered, we were in a pool without waves, told what to do and think, were given alphabetical identities and evaluated by the letters A to F. In both swimming and in academe, procedures seemed to have been established more for the benefit and ease of the teachers rather than in the best interests of student learning abilities. I wanted to turn that around, changing some of the progressions and assignments. I saw no reason why we could not deal with larger groups of students on a more personal and individual basis.

The ideas began to formulate at the swimming pool first. Conventionally, swim students were separated into several classes, roughly similar in skill and distributed around the pool. We were allowed ten half-hour lessons to get them to swim back and forth with free-style strokes and occasional breathing exercises. We were also supposed to teach some sort of back stroke and provide them with a deep-water challenge to illustrate they were "drown-proof." It seemed terribly inefficient. We would spend an entire lesson just getting everyone's face in the water. Half of the students would only pucker-up and dip their chins in, barely wetting their noses! Like a ship convoy, we could only move at the speed of the slowest student. What was so sacred about standardization? Why did everyone have to learn at the same pace? And in the same order of skills?

Not totally naive, I did recognize that Swim School was a business enterprise requiring profit from satisfied customers. Yet I was obstinate in trying to find a way in which a teaching sequence could build successful experiences, could help dissolve fear, remove individual blocks and lead step-by-step to new levels of awareness and ability. Another purpose may also have been lurking in my psyche – to undermine the unfair habit of catering to "faster" students, to gratify ever-watchful mothers and to earn public relations points with the boss. This was an easy pit to fall into, since many of our younger students were children of well-known film stars, practicing their attention-getting antics on the teachers.

There came a day when I began with a new group of children and decided to ask the boss if I could experiment with some of the methods. Literally taking the plunge, I got into the water with the students, as I had previously done in private lessons. Instantly, I was less an authority-figure and more of a partner. I was visible, and my own floating gave direct and accessible proof of support, equality and respect for their position.

The first thing I said was, "DON"T GET YOUR FACES WET!" Surprise and disbelief. I showed them how to lean back in the water until they lost their balance, take a deep breath and gently push with their toes. It was the beginning of the back float. Giggling and squealing as they tried to keep their faces out of the water, they mischievously ducked under entirely, just to yell about how wet they were, learning at the same time to hold their breath or breathe when they needed to. Best of all, they kept on doing it by themselves, calling each other to try another way to succeed better, allowing me to go about giving individual help.

We tried push-offs from the pool side. I stood behind them as they let go and slowly stretched out backwards into the unknown. (I wished my professors at college had done the same with me – let me rush off to the challenge of unfamiliar knowledge, knowing that they were behind me, but letting me use what I already knew as a base and allowing my own strength and determination to accomplish the remainder.) As I stood farther away in the water, the children glided several feet in no time at all, a rather advanced skill for basic beginners.

The real significance was that they relaxed, floating and gliding on their backs, breathing freely and able to stand up with no help from me. The learning had been accomplished through playing games without any apparent rules or formal instruction. No one had been afraid, no one had cried, and most important, *no one had failed*. This certainly was not what was happening at the university.

With basic guidance rules, my swimming children dared to try new concepts; one rolled over from his backward float, put his face down in the water and dog-paddled naturally back to the edge. It was his "invention"! He had taken what we practiced, what he felt comfortable with, and extended it to the next reasonable stage. The other kids tried it too, and I realized it was not competition, but a sharing of the discovery, a giving-up of one's own creativity to let others experience it too, thereby gaining the rewards of praise, exhilaration, and accomplishment for oneself. I was fascinated; my experiment was allowing the kids to teach each other!

They were teaching me too. They were noisily excited about their rapid success, so much so that some mothers and teachers spoke to the boss about the "hilarious goings-on," wanting to know when the serious teaching would begin. My colleagues did not appreciate what they saw as a lack of seriousness, order and discipline in my classes, and said my kids made too much noise. I was reminded that we were all supposed to be doing the same thing, that "playtime" was the final five minutes, and only if the lesson had been effectively completed.

It was patiently explained to me that I was the junior teacher and that intermediate and advanced lessons involved specific higher-level skills which I should not intrude on, since the senior teachers would be handling those classes. I was praised for my high-quality work, but I was also told that I needed to remember my function in the larger system!

While I burned, I also accepted the merits of some of the complaints. One did need to be aware of learning innovation, and also of appearances and public consequences in the paying-customers situation. I understood the mothers' concern and competitive point-of-view, and it was obvious to me I would have to improve my "marketing" tactics. Smiling inwardly, I told the kids to have their fun more quietly, and we learned to laugh and giggle in whispers, which was even more satisfying, because I was thus able to continue my own thing and avoid conforming to the rigid, ineffective, tried-but-not-so-true Red Cross rules.

I was to use these non-traditional lessons for the next two decades of swimming instruction, later modifying the ideas in my university teaching to adult students in the humanities. Questioning my colleagues about trying new and different methods of teaching, both in swimming and university classrooms only frustrated my idealistic attempts to "improve" the system – only a few were really interested in talking about it. I had previously assumed teaching was an Ivory-pure, Virtuous World – after all, which was more important, helping students develop maximum potentials, or confining their pace and progress? Theory versus actuality: how could one handle, teach and grade large groups of students without categories and frameworks? At the same time, how could one prevent falling into the trap of bureaucratic limitations and turf-disputes that existed for the sake of the bureaucrats?

How could one keep learners enthusiastic if their success-buttons were not being continually pushed as new challenges were offered? Who decided there should be a limit to growth and numbers of competencies? If learning could be accelerated, why not do it? If students would respond positively to higher expectations, why not increase the numbers of skills and diversity of approaches? Were priorities and regulations dictated by the system and the convenience of the systematizers? Or were they really for the improvement of learning and learners?

My own answers were crystal clear; deep water held no fear as long as the students were prepared mentally and emotionally in advance about being confident, while respecting the water and using caution in new situations – rather than being made to feel unprepared and incompetent. I believed that if all persons were doing their best and at the most satisfactory pace they could muster, then they would learn far more and much faster than in the traditional atmosphere of listen-and-imitate. As they became comfortable with one skill they could naturally move on to the next and be encouraged to anticipate what lay ahead. Finding the best way to do that was my goal.

I could not see life or teaching as a competition or contest between students. Each person is distinctive, unique – each can only be one's best possible self. We are not interchangeable cogs in a wheel, even if many societal forces push us in that direction. We can only function effectively as individuals in a group-society if we pay attention to other people's personalities, positions, agendas and expectations, even if some fundamental foundations must be laid.

Unexpectedly, I had to put my beliefs and practices to the test one day in the swimming pool. It was not careful pre-planning, but the result of my having spent a lot of time with my "beginners" in the shallowest end of the pool. As we played all of our confidence-building games, I had not paid attention to what the other teachers had been doing, and when I wanted to move out into slightly deeper water for cross-pool exercises, I found that every space in the pool was taken up by other classes, except one: the deepest part under the diving board.

An enormous window opened up and my misgivings and anxieties flew away. Instinct told me I had to get the kids into the deepest water for their own sake, for mine, and also to pacify the mothers. I had not figured out precisely what we would do once we got there, but I knew we would all be okay because we knew how to swim in the shallow water. As we all walked along the deck to the deep end, I was conscious the pool had become very quiet and everyone was watching us, including the boss! Acting as natural as possible, but with my heart beating in anticipation, I climbed down the poolside ladder into eight feet of water. The kids followed me, giggling and lively without a sign of fear or protest, and inched over, one by one to hang onto the side edge.

Treading water, I had them do their same back-glides to me, catching them and shoving them back to the edge again, one at a time. Each time they repeated their thrust out into deep water, they traveled a little farther. (I recall how in doing a big research paper for ancient history, I had simultaneously delved into subjects that compared or contrasted with my thesis, finding they actually <u>were</u> related in ways I had never suspected, making the paper more interesting and earning positive comments from the professor!) As our little group continued to throw themselves backward farther and farther from the wall, some went clear across the pool on their backs, kicking their legs and sculling with their hands, laughing and squeaking with delight in eight feet of water! I was ecstatic, and so were the mothers.

We invented a new game called ELEVATOR: you take a big breath, climb down the ladder to the bottom of the pool, let go, wait patiently, and allow the built-in "buoyancy elevator" to bring you back up to the top. At the second try, they were joyously showing each other how explosively they could bounce out of the water from the depths of the bottom rung.

Lesson-time was over, and we had five minutes of free-swim. With no warning, several of the children clambered out, jumped feet first off the diving board, surfaced, rolled onto their backs and sculled over to the wall, got out and went to do it again. I tried not to let my astonishment show, keeping a poker face when it was time to mingle with mothers and onlookers. What a success it was! The kids enjoyed their triumph, the mothers lavished proud praise, and the boss told me that she knew that her faith in her teacher had been appropriately placed.

I had taken the responsibility of doing what I believed to be useful, to stay out of the way of other teachers, and avoid encroaching on other turfs. I had helped each student through every water-confidence maneuver I could invent, equipping them for whatever instruction might be required from any subsequent teacher. The students had gained confidence from their own accomplishments.

For the final lesson in the series I wanted to complete my experiment in blazing new trails by presenting a solid demonstration of the children's skills and stamina. I talked with them about staying in the deep end of the pool for twenty-five minutes without coming out or touching the sides. We all agreed there would be only two rules; we had to stay in the water under our own power and we could not touch anyone else. We could float, tread water, talk quietly, bob up and down, swim in a circle, or whatever we wanted.

In we went, the children enthusiastically treading like little machines. They became bored after awhile, so I took off my floppy straw sombrero and tossed it over to one of them to play "pass the hat" for several minutes. Then we made believe we were riding bicycles, then floated with our arms folded, next copied the movements for "Simon Says," and finally performed "silent swimming" in a circle. Then it was over. Every one of them had made it through the entire period without touching the walls or hanging on to each other: a fabulous "drown-proofing" exercise. They all graduated by getting their certificates from the boss.

Many years have gone by since the evolution of those swimming lessons and all they taught me, but their underlying truths remain. One cannot measure people against each other without creating winners and losers – and while success may encourage, failure clearly discourages. Nor can you fib to a student by over exaggerating the excellence of their feat – encouragement is one thing while "blarney" is another, and they know the difference! You have to push some kids harder than others, and need to find special phrases for different situations, but positive, realistic encouragement promotes effort and growth.

Insults or negative criticism diminish personal confidence and the desire or even willingness to try new things, while at the same time diminishing one's status in the eyes of other students, producing embarrassment and even hostility. Safety and personal confidence is more useful and significant than being the first or the fastest. I helped people learn how to learn by doing, by thinking about it, and by helping each other with the learning. The key was to know each person, paying attention to what skills, understandings and needs were being revealed by individual feedback, and then to help each one move forward to the next step. No absolute formula existed, only a personal sensitivity and a sense of direction.

I can now find pleasure in reviewing my swimming experiments, since they have come to be used continuously in individualizing learning, assignments and evaluation in my university classroom (taught now via interactive instructional television to fifteen communities around the state of Arizona simultaneously). Learning several sets of principles and applying them in various ways, students design their own evaluation projects on which they will be graded. They only need to demonstrate through application that they have understood our course principles.

Their use of ladders into and out of the deep water leads them to new rungs of confidence in accomplishment and personal scholarship, each one an individual, each one capable of floating with assurance in personal buoyancy, each functioning effectively within their respective areas of choice. Their teacher, or rather learner-helper, has established a comfortable arena, has provided a series of learning experiences that move step by step to a higher level of competence, has allowed and encouraged the students to find their way, and has remained nearby in case assistance is needed. The learner does the work and gets the reward. I wonder if the reward and satisfaction is not even greater for the learner-helper.

Editor's Note: State and national education systems are guided by policy. Lebusa Monyooe relates survival in the "shifting sands" of the Kalahari to educational needs in a world of ubiquitous and relentless change. His focus goes beyond alignment of curriculum policy and assessment with education practice to a symbiotic relationship. "*There is more to alignment than matching tests and standards. Alignment provides a synergy between policies, resources, curriculum, teaching, learning, and assessment strategies.*"

Distance learning, with its ability to cross local, state and national boundaries, must be sensitive to research findings, cultural differences, and the ever-changing social, economic, and political environments. This paper is not limited to policy makers and politicians. It explains how each of us has a role in changing the processes and products of education and its ultimate importance to quality of life.

On Shifting Sands: Exploring the Curriculum and Assessment Dichotomy

Lebusa A. Monyooe

Abstract

This paper argues that a better alignment between curriculum policy and assessment practices has the capacity to change and transform the profile of educational institutions. To achieve this challenge, it advocates for a critical reflection on curriculum and assessment discourse especially by:

- Exploring the curriculum and assessment dichotomy
- Utilising the capacity building logic as a strategy to enhance alignment of curriculum policies and assessment practices
- Adopting curriculum policy and assessment and practices that are congruent with institutional differentiations and contextual dynamics
- Utilising the research logic to inform policy decisions and practices.

Introduction

'On Shifting Sands' as a conceptual metaphor for this paper is a consequence of my interest in documentaries about nature. Part of this intrigue is attested to by my interactions with those who venture to explore experience and capture the mystical nature of the Kalahari. They describe the Kalahari as a manifestation of mystery and phenomenal human experience. To explore and experience the mystical nature of the Kalahari, they must demonstrate impeccable skills of discernment and exigency to cope with treacherous conditions and the ever-cascading sand for survival. For their own survival, the verbatim '**Keep your eyes on the shifting sands'** reverberates in each explorer's mind. It is indeed a constant reminder about the danger that is always lurking around them. Similarly, educational planning and provisioning is about the life and death of the nation. Poorly planned educational systems condemn nations to extinction.

This paper is not about the Kalahari explorations and concomitant dangers that such expeditions pose to potential explorers. It is about the changing perspectives in curriculum and assessment discourse. Through the use of the metaphor, 'On Shifting Sands' as an epitome of mystique and thermotaxis, the paper sets out to explore and interrogate the dynamics of aligning curriculum policy and assessment practices. It argues that a better alignment between curriculum framework and assessment practices is a plausible strategy to optimise educational change and transformation.

Exploring Curriculum and Assessment Dichotomy

Over the past years, there has been an unsurpassed global interest in educational transformation discourse. This was a consequence of public outcry at the poor performance of learners across the curriculum. It was also due to huge financial expenses incurred as a result of dysfunctional educational systems. At the heart of these deliberations, is the need to find a lasting solution to educational challenges. This has led to a proliferation of educational initiatives across nations. Whether these curriculum initiatives will yield positive results is a subject of speculation. According to Harris (2000:1):

> *In most western countries the pressure for change has manifested itself through government policies aimed at generating the impetus for school development. In reality, however, such policies have often proved counter-productive to innovation and change. The current dichotomy facing schools is one of greater central accountability and control, with an increased responsibility for self-management and development.*

What Harris posits is relevant to the changing educational landscape in South Africa. The South African National Qualifications Framework (NQF) that sets the broader context for educational transformation in the post-apartheid era makes it quite evident that there is need to measure educational outcomes against predetermined standards. These standards are provided for in the new curriculum framework that, in addition to stating the expected outcomes of education generally, lays down the minimum standards required from the teaching and learning processes across grades. This reflects a paradigm shift from inputs to processes and outcomes of schooling.

The adoption of the NQF is intended to integrate all aspects of education and training in this country. A key aspect of this framework is the recognition of skills and abilities of individuals at various levels of competency as stipulated across learning programmes. The enactment of both the legislative framework and policies is intended to achieve the set goals. It is about systems and alignment thereof. Whether such forms of alignment yield expected results, is another theme for interrogation. In the words of World Declaration on Education for All (UNESCO, 1990):

> *Whether or not expanded educational opportunities will translate into meaningful development for individual or for society depends ultimately on whether people actually learn as a result of those opportunities, in other words, whether they incorporate useful knowledge, reasoning ability, skills and values…*

At the heart of this questioning is the need to have systems in place to optimise the functionality of institutions of learning. The functionality of an organisation can be determined by its structural framework, professional capacity and expertise and organisational systems. This includes the crafting and utilisation of institutional development plans to enhance debate around curriculum and assessment issues.

Both curriculum and assessment are dialectically interwoven. The tendency to view them as separate dichotomies is misleading and tends to complicate their operationalisation. For curriculum initiatives to be declared credible, they ought to have well defined assessment framework and modalities of implementation. According to Walstad (2000: 1) "…it is difficult to separate assessment decisions from teaching decisions. Teaching and assessment in …classroom are interconnected, as one affects the other". What Walstad articulates about assessment and curriculum interconnectedness, is both relevant and instructive in that it highlights the need to apply a holistic approach to assessment and curriculum decision-making. It also alludes to the need to demystify the notion of curriculum and assessment dichotomy. Furthermore, a lot of instructive strategies can also be derived from Fullan's (1993) scholarship on educational change and development. For instance, Fullan (1993:3) reminds us:

> *Change is ubiquitous and relentless, forcing itself on us at every turn. At the same time, the secret of growth and development is learning how to contend with the forces of change - turning positive forces to our advantage, while blunting negative ones. The future of the world is learning the future".*

What Fullan suggests is further supported by Senge (1990) as cited by Fullan (1993) reminds us that the Greek word *metanoia* means 'a fundamental shift of mind'. Both advocate for a new framework for doing things. This applies also to adopting a new perspective on curriculum and assessment discourse.

Darling-Hammond and Bullmaster (1997: 1075) remind us that:

> *If today's educational reforms are to succeed, they will require highly educated and well-prepared teachers who can make sound decisions about curriculum, teaching, and school policy. Indeed, all the solutions to the problems cited by contemporary education critics are constrained by the knowledge and capacities that those teachers possess, and by the school conditions that define how that knowledge can be used.*

Evidence gleaned from literature on teacher education initiatives across the globe confirms that one of the challenges facing the teaching profession for the 21st century include a continual transformation of teacher education programmes that empower teachers in curriculum design and development including assessment practices (Giroux & McLarren, 1987; Grundy, 1987; Punch & Bayona, 1990; Darling-Hammond, 1994; Darling-Hammond & Cobb, 1995). According to Cutterbuck (1995)

Empowerment in its diverse forms becomes a springboard on which curriculum innovations can successfully be launched. He sees empowerment as a psychological drive that activates human beings to reconstruct their attitudes, perceptions and environment in which to actualise their dreams. It is a necessary mind shift that enables role players in education to embrace change.

Curriculum And Assessment Alignment: Striving for Thermotaxis

According to Darling-Hammond (1994: 25):

> *Changing assessment forms and formats without changing the ways in which assessments are used will not change the outcomes of education. In order for assessment to support student learning, it must include teachers in all stages of the process and be embedded in curriculum and teaching activities…assessment must also be an integral part of ongoing teacher dialogue and school development.*

What Darling-Hammond posits raises questions about policy formulation, implementation and management. Part of the questioning is a consequence of public outcry about the poor learner performance and achievement. Furthermore, it is also a consequence of the impact of globalisation on educational systems. For countries to compete globally, they need to implement educational policies that are responsive to global challenges. Educational policy framework is at the centre of curriculum and assessment discourse. It becomes a mechanism that determines the nature of the education system and how it should be aligned. Obviously, the modalities of aligning the various components of a system will differ from context to context. Nevertheless, the following indicators form the basis for a school level alignment strategy:

- Policy framework
- Educational goals and objectives
- Institutional outputs
- Delivery systems
- Assessment and evaluation strategies and
- Learner performance and achievement.

To operationalize alignment strategies, schools need to evaluate their capacity and commitment to curriculum and assessment alignment.

Traditionally, curriculum alignment was perceived to imply achieving a match between tests and standards as given by the national framework. The areas of focus were:

- Content
- Performance
- Level of difficulty and
- Balance and range.

There is more to alignment than matching tests and standards. Alignment provides a synergy between policies, resources, curriculum, teaching, learning and assessment strategies. It serves as 'the logic between policy goals and the strategies enacted to meet those goals'. Alignment also serves as an accountability framework for improving learner performance and achievement across the curriculum. Policy alignment is a critical aspect of educational change and curriculum reconstruction. There is need for both vertical and horizontal alignment of policies to classroom contexts. Progress towards achieving such a synergy depends on the complexity of the components to be aligned and mechanisms set in place to facilitate the envisaged alignment initiatives. Another aspect that needs mentioning is the capacity of institutions to deal with policy issues.

The current educational changes also afford role-players an opportunity to raise questions about the relationship between curriculum and assessment. This is a consequence of the tendency to perceive school effectiveness in terms of how schools perform in national examinations. Although, this is narrow and misleading, it nevertheless, demonstrates the public's passion about examinations. Whilst the debate about the value of terminal examinations rages on, critical questions about the curriculum and assessment dichotomy retain prominence. The unpacking of such a discourse enables us to gain a better understanding of how educational systems operate.

Educational assessment is viewed as a pivotal strategy around which national reforms should be anchored. Learner assessment in particular, has undergone profound changes. Traditional forms of assessment have been criticised for failing to establish a link between classroom methodology and what achievement tests purport to test and evaluate. It is against this background that Madaus (1994) argues that assessment practices like curriculum policies tend to favour the mainstream ideology. This according to Popham (1991) and Simmons and Resnick (1993) has led to a proliferation of state designed assessment frameworks. The use of state designed assessment strategies have been criticised to ignore contextual circumstances. To address this challenge, Darling-Hammond (1994:5) argues:

> *Top-down support for bottom-up reform where assessment is used to give teachers practical information on student learning and to provide opportunities for school communities to engage in 'recursive process of self-reflection, self-renewal'… the equitable use of performance assessments depends not only on the design of the assessments themselves, but also on how well the assessment practices are interwoven with the goals of 'authentic school reform and effective teaching'.*

What Darling-Hammond posits is central to the current debate on the curriculum and assessment dichotomy. It also illustrates the need to align curriculum and assessment policies and practices.

Curriculum alignment is not a simple feat. It is a complex process that requires meticulous planning and optimal realignment of policy frameworks and classroom practices. Institutions of learning need to ensure that there is a 'fit' between what policy articulates and what actually takes place in our schools. In other words, do teachers follow national curriculum mandates? How closely interrelated are both their teaching and assessment strategies? Failure to achieve the desired level of alignment has serious educational implications. The importance of alignment in educational context is illustrated in figure 1.

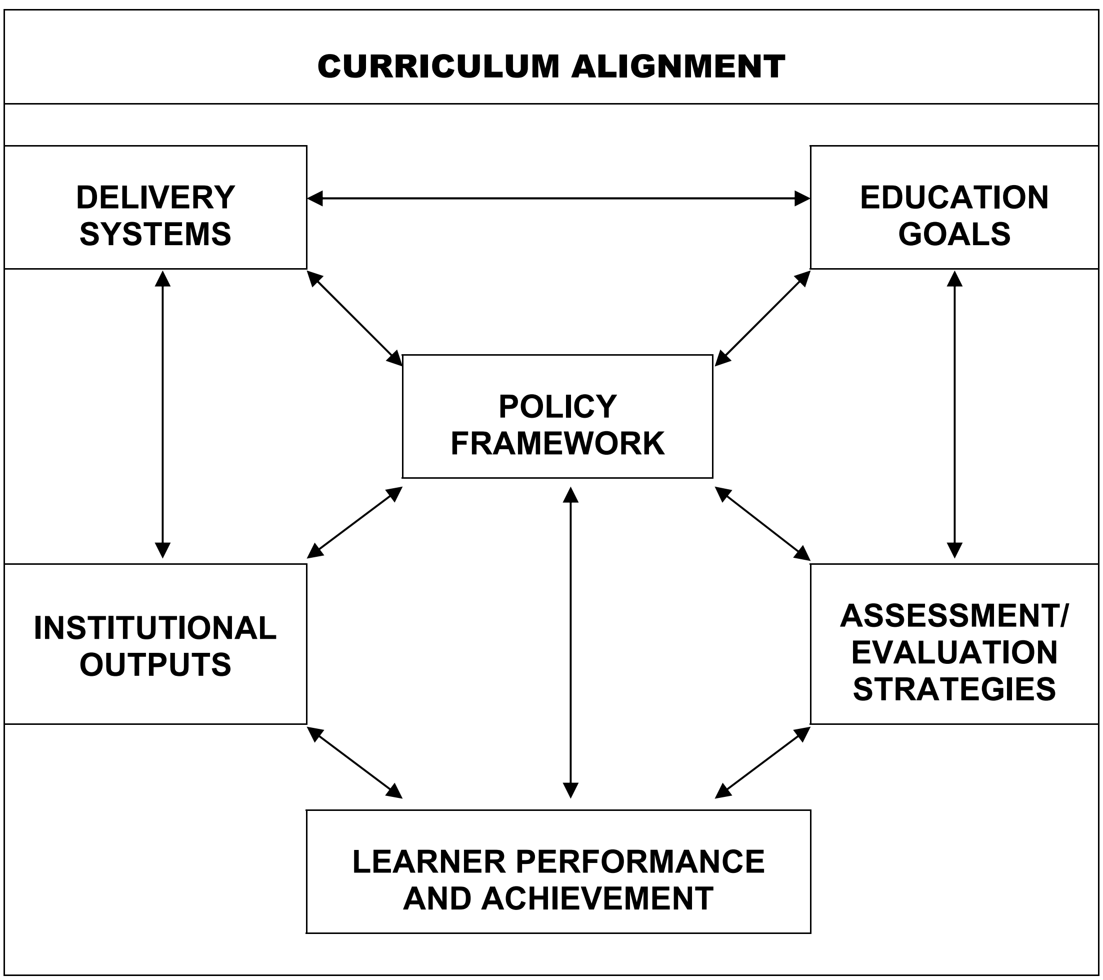

Figure 1. Curriculum Alignment

Maintaining balance between curriculum policy and assessment practices is a complex and daunting task. It is therefore, fitting to liken it to thermotaxis. What then is thermotaxis? It is a process by which warm-blooded organisms regulate their body heat and temperature. The notion of thermotaxis aligns well with the conceptual metaphor 'On Shifting Sands' as used in this paper. Weather conditions in the Kalahari change without notice, thus requiring explorers to acclimatise for survival. Failure to maintain thermotaxical balance could prove fatal. Likewise, institutions of learning cannot function optimally unless they have sound systems and function efficiently. They have to maintain a healthy balance between curriculum policy and assessment practices. Failure to strike a balance would render such institutions worthless and irrelevant to the socio-economic needs of the society.

Barnes et al., (2000: 645) argue that the principle of alignment should be viewed as:

> *a degree of congruence between the expectations of a school system for students' performance and the various elements of the system's assessment arrangements. A corollary of this principle might be that expectations and assessment should be aligned in a clear, efficient, and economical manner".*

Barnes et al, raise questions about systems functionality. Implicit in their argument is the need to have focus and mechanisms to attain the set goals or objectives. They argue that as a consequence of lack of (poor) planning, different and confusing curriculum mandates (messages) are often sent to various role-players about implementation strategies. Since there is no logic between curriculum mandates and operational framework, implementation becomes problematic. Similar views have been expressed by Fullan (1999: 66) who advocates for "a better alignment between curriculum, pedagogy and assessment at both system and school level".

In their study Barnes et al (2000) provide some empirical evidence that falsifies the assumption that assessment is a neutral element in curriculum discourse. They demonstrated that on the contrary, assessment is a:

> *Powerful mechanism for social construction of competence…Investment in quality assessment offers school authorities a powerful, cost effective means to model exemplary practice, while meeting the evaluative obligations of public accountability.*

Their research analysis further highlights the need to ascertain that curriculum content is credible and relevant. They caution that the dynamics of the alignment logic should not be delimited to establishing synergy between curriculum expectations, teaching strategies and assessment practices. They recommend that to circumvent public displeasure regarding alignment processes, alignment discourse should also focus on the system's expectations and assessment strategies thereof. Webb (1997: 2) also cautions that "a careful alignment between expectations and assessment should be pursued to avoid 'over assessing a few outcomes at the expense of ignoring others".

According to Barnes et al, a careful alignment of curriculum expectations and assessment practices generates a strong causative impact on classroom pedagogy. On the contrary, poorly aligned curriculum expectations and assessment mandates tend to exert 'coercive influence on classroom practices'. They caution that assessment mandates should not be used to restrict classroom practices, but rather reflect the range and scope of performance as articulated by the curriculum framework. This leads us to another critical question, namely, how is alignment measured? A review of literature on curriculum initiatives (Biggs, 2001; Shuell, 1986, Burns, 2001) confirms that the process can be achieved through the following strategies:

- Using National Frameworks
- Expert Consensus
- Benchmarking
- Common criteria etc.

The process of aligning curriculum and assessment practices requires the existence of a quality assurance framework. A review of literature confirms that benchmarking is often used as measure of quality control both in academia and business sector (Loosemore, 1996 & Mawson, 1994). Mawson (1994) defines benchmarking as ‘a technique by which an organisation can compare its own methods, processes and practices and performances against other organisations’. Similarly, Losh (1994: 62) defines benchmarking as:

> *A systematic way of identifying the practices of successful enterprises and implementing them… Ultimately this is an inquiry process designed to identify what works and why? Once a successful practice is identified, it becomes a benchmark and serves as a reference point for establishing internal goals and objectives for increased performance.*

Housley (1999) notes the following types of benchmarking:

- Generic benchmarking
- Competitive benchmarking
- Performance benchmarking
- Product benchmarking
- Functional benchmarking
- Cost benchmarking
- Process benchmarking etc.

It is not the intention of this paper to account for the many approaches to benchmarking. Nevertheless, a synopsis of both Process and Performance benchmarking will be given since they have some relevance to curriculum and assessment dichotomy discourse. Process benchmarking focuses largely on what makes systems functional and efficient. This includes gaining a better understanding about the functionality of both the organisational and management structures. Performance benchmarking, on the other hand, deals with the quality of system’s outputs. In a nutshell, it’s about the aggregation of the performance outputs as outlined by the system’s performance indicators.

Exponents of benchmarking (Housley, 1999; Loosemore, 1996; Mawson, 1994; Price, 1994) cite the following benefits of benchmarking:

- Improved quality
- Maintenance policy
- Management information systems
- Improved processes
- Change facilitation
- Gained competitive advantage

- Flexibility
- Weaknesses identification
- Improved cost etc.

Every approach has operational limitations. This also applies to the use of benchmarking in educational context. If not carefully planned and utilised benchmarking can lead to over bureaucratisation of educational practices. Despite such limitations, benchmarking can bring substantial changes and improvement in an organisation if used intelligently. In the words of Housley (1999: 79) "Benchmarking is not a 'fad', and can be a 'fix' if used to bring about improvement. But benchmarking will be seen as a fad, and an expensive one …if it is used to measure outputs".

Fullan (1993: 84) reminds us "learning organizations are a part of a greater complexity that requires a holistic view to survive and develop". An articulation firmly embedded in the conceptual metaphor used in this paper. Similar views have been articulated by Land and Jarman (1992: 30) who argue:

> *The reality of evolutionary success demonstrates that 'fitness' is not simply about 'adopting to an environment', but rather the continuing improvement in the capacity to grow and build ever more connections in more varied environments (we define growth and evolution as continuously making more extensive and increasingly complex connections inside the growing organism and with the varied outside environments).*

The cumulative evidence gleaned from literature on school change and development (Barnes et al 2000; Land and Jarman 1992; Fullan 1999 & Webb 1997) demonstrates that curriculum alignment processes should be underpinned by the provision and optimal utilisation of the following critical system's structures:

- Leadership
- Organisational structures
- Access to resources
- Personal and social dynamics
- Institutional context etc.

The leadership capacity of an institution is crucial towards achieving national standards and outcomes. It does so by ensuring that appropriate systems and processes exist to enhance the functionality of schools. The common view is that there is a link between strategic planning and institutional effectiveness. Through a carefully planned strategic framework, institutions can transform their profiles. Huggins (1980:4) defines a strategic plan as 'the systematic process of setting…objectives and making the strategic decisions and developing the plans necessary to achieve these objectives'. According to Huggins (1980) strategic plans offer institutions an opportunity to map up contingency options to anticipate contextual challenges and plan accordingly to circumvent such eventualities. Like 'Shifting Sands' strategic plans have to be reviewed from time to time to ascertain their viability. Maintaining balance between institutional plans and their core business is another form of thermotaxis. Like the Kalahari explorers who rely on impeccable skills for survival, institutional plans too have to be well crafted and should reflect:

- Vision and mission
- Institutional functions

- Quality assurance policy
- Capacity building policy
- Research policy and
- Community partnerships.

A better synergy between these components has the capacity to facilitate curriculum and assessment alignment processes within and across institutions. The processes alluded to above depend largely on access to resources, professional relationship among role-players and the overall capacity to manage change.

Utilising the Capacity Building Logic to Enhance Curriculum Alignment

The success of institutions depends inter alia, on their capacity to grapple with change and related challenges. Institutional capacity building plays a crucial role towards transforming the profile of an institution. Institutional capacity building therefore, can be achieved through:

- Visionary and transformative leadership
- Comprehensive strategic plan
- Plausible implementation strategies
- Maintenance plan
- Adequate resources
- Will to invest in capacity building endeavours.

In his foreword, Spady (1998:vii-viii) offers us a most compelling form of leadership that would equal the task, when he avers: (i) it should be leaders who initiate improvements in their milieu or organisation (ii) leaders that get results by enlisting the support of others and sticking to their goal, and they make something better and different. The resonance of Spady's thesis is supported by Makgoba (1997:140). He proposes a paradigm shift in institutional leadership and praxis. He argues that such a shift would give leadership a new meaning and profile that "…must develop a new understanding of diversity that enables a real departure from the legacies of the past such as the dominant and recessive power relationships that are rampant in our institutions of higher learning".

Literature on educational change and leadership confirms that skilled and knowledgeable leadership has the capacity to transform the way institutions function (Giroux, 1987; Harris, 1994; Nkomo, 1998; Schwahn & Spady, 1998). Lenin once retorted "do not try to resolve new challenges by old methods. Nothing will come of it". Lenin's retort remains truly relevant as institutions grapple with the 21^{st} century challenges. Lenin's words of wisdom are further vindicated by Gorbachev (1988) in his address to the CPSU Central Committee, Heads of the Mass Media, Ideological Institutions and Artistic Unions on: **How to Restore the Image of Socialism through Democracy.** He argues "The creative forces of society have been set into motion. Positive tendencies are appearing. This is exactly what changes life". The culture of life in our institutions of learning must change to meet the ever-changing needs of learners. Institutions need to cogitate a plausible institutional "perestroika" that would unleash capacity building initiatives inherent within these institutions. Professionalism, solid scholarship and impeccable work ethos should be a plausible scaffold upon which institutional capacity building strategies are anchored.

According to Darling-Hammond and Bullmaster (1997: 1071):

> *Developing a capacity for understanding requires both the time for this kind of extended, in depth learning, and the skilful guidance of teachers who can scaffold key ideas, anticipate misconceptions or stereotypes, and create learning experiences that build on students own thinking and reflect the standards for inquiry in the discipline.*

Undoubtedly, professional development plays a critical role to transform pedagogic credibility of institutions of learning. In order to teach effectively teachers need to have a better understanding of the disciplines they teach as well as the many different ways in which children learn (Darling-Hammond, 1990; McLaughlin & Talbert, 1993; Shulman, 1987). As McLaughlin and Talbert (1993: 2-3) argue:

> *Teaching for understanding … requires change not only in what is taught but also in how it is taught… Teaching for understanding requires teachers to have comprehensive and in-depth knowledge of the subject matter, competence in representation and manipulation of the knowledge in instructional activities, and skill in managing classroom processes in a way that enables active student learning.*

The thrust of McLaughlin and Talbert's thesis underscores the need for teachers to understand the dynamics of curriculum policy and assessment practices. They need to foster meaningful learning by designing appropriate learning tasks that engage learners to explore the frontiers of knowledge. Unfortunately, evidence gleaned from literature confirms the contrary (Darling-Hammond & Bullmaster, 1997;Fullan, 1993; Senge, 1990). For instance, classroom experiences reveal that the majority of teachers in developing nations struggle to establish synergy between classroom curriculum and assessment practices. This is a result of teachers' lack of understanding and knowledge of curriculum design and development. As a consequence of this professional deficiency, there is no 'fit' between what teachers teach and assess. Teachers' lack of appropriate and relevant skills in curriculum design and development is a major challenge that teacher education providers have to address urgently. According to Darling-Hammond and Bullmaster (1997: 1073):

> *…Teachers will need to be prepared to teach in the ways these new standards demands, with deeper understanding of their disciplines, of inter-disciplinary connections, and of inquiry-based learning. They will need skills for creating learning experiences that enable students to construct their own knowledge in powerful ways. In addition, teachers will need to understand and use a variety of more authentic and performance-based means for assessing students' knowledge and understanding, as well as evaluating students' approaches to learning.*

Commenting on the invaluable role and expertise teachers bring to the classroom Shulman (1983:504) avers that:

> *The teacher remains the key. The literature on effective schools is meaningless, debates over educational policy are moot, if the primary agents of instruction are incapable of performing their functions well. No micro-computer will replace them, no television system will clone and distribute them, no scripted lessons will direct and control, no voucher system will bypass them.*

What Shulman poses is both relevant and instructive as it raises questions about educational system's efficiency and credibility in addressing teacher empowerment issues. According to Fullan (1993) society in general has failed to acknowledge complexity of the teaching profession. He also blames society for bashing teachers for poor education results without first creating conducive conditions that would make teaching and learning successful. He further argues that teacher educators and teachers have not been proactive enough to break the cycle of dysfunctional systems.

To break the cycle of dysfunctionality, Schlechty (1990: 22) argues:

> *Teacher education could, I believe, be much improved if those who sought entry could be brought to understand that learning to teach requires considerable investment of time and talent. Thus, it is in the interest of quality teacher education to create conditions in which talented individuals are willing to enter programs that require them to undergo a longer period of development than is commonly the case in present teacher education programs.*

Radical changes in teacher empowerment programmes are required to translate Schlechty's sentiments to reality. Schlechty's thesis is reiterated by Lichtenstein et al (1992: 80) who argue that the nature of teacher education programmes should maximise on "the knowledge that empowers teachers to pursue their craft with confidence, enthusiasm, and authority". Arising from Lichtenstein's proposition is the need for teachers to display sound knowledge and understanding of the following critical aspects of a school system:

- Knowledge of teaching profession
- Understanding of education policy
- Knowledge of learning programmes (disciplines)
- Knowledge of teaching and learning strategies and
- Understanding of assessment practices.

A display of both the knowledge and understanding of the above named aspects of the school system forms an important step towards understanding the dynamics of curriculum policy and assessment practices. Part of such an understanding is underpinned by the research capacity building opportunities within institutions of learning.

Utilising the Research Logic to Inform Policy Decisions and Practices

The upsurge of interest in research is a consequence of a plethora of factors, for instance, to promote the culture of accountability within institutions. Research is also used as a monitoring tool. This is as a consequence of the huge financial resources invested in educational initiatives. It is also an attempt to demystify public perceptions and distrust about research initiatives. It is also because of high expectations accorded to the science of research in education. Evidence gleaned from literature on research studies confirms that research plays a crucial role to provide pertinent data on the quality of educational systems and practices (Mwamwenda, 1994; Nyamapfene, 1999; Harris, 2000).

In 1999, the Gauteng Department of Education (GDE) hosted a conference on '*Educator as Researcher*'. One of the primary aims of the conference was **"To move research agenda to the center of change process in education"**. The long-term vision of the conference was to encourage dialogue about strategies institutions might use to facilitate educators' transition to the world of research in order to become 'critical scholars'. The reality is that institutions cannot microwave researchers. It is a process that requires time, training, commitment and resources. According to Nyamapfene (1999) doing research is an imperative requirement for those entrusted with the responsibility of academia. He concedes that research capacity at institutional level needs to increase to match academic challenges. He believes that those involved in research are active thinkers committed towards utilising the research logic to construct knowledge and add to the knowledge discourse. The need to strengthen institutional research capacity is supported by Noble (1989) and Mwamwenda (1994).

The role of teachers in research should be explored as a strategy to enhance their growth as classroom researchers. This is also critical so that they log into research databases to inform their practice. Attempts to encourage teachers to become 'critical scholars' and actively participate in research projects should be underpinned by:

- Strong research leadership
- Mentoring and research capacity building
- Plausible development plan that clearly articulates institutional vision and research priorities
- Effective organisation and management of resources to optimise research outputs.

The impact of research in educational transformation and curriculum reconfiguration is well documented. According to Mwamwenda (1994) research plays a crucial role in shaping educational systems. For instance, it helps institutions to redefine their core business within the ever-changing global context. He argues that decision-making in education should be a consequence of research outputs. He concedes that lack of research output would compromise the image of the institution both nationally and internationally. In this case, it would even compromise the policy systems of such a country. In addition, Wickham and Bailey (2000) believe that research further enhances:

- Sharing and collaboration among stakeholders
- Dialogue on various educational issues
- Communication between teachers, learners and policy planners
- Performance levels of teachers and learners
- Teacher designed staff development initiatives
- Developing priorities for school planning
- Development to new forms of knowledge

The quality of research outs can be optimised by developing the culture of research within institutions of learning and relevant support systems. The strategy for achieving such a task is succinctly elaborated by Gaynor (1998: 70):

> *Pedagogical research must be strengthened to improve the quality of education. For example, in-service and action research should be carried out, and the research should be communicated to teachers in an effective manner. Schools must be allowed to have a direct input into the research process by, for example, becoming involved in research design and implementation.*

A cumulative analysis of scholarship on research confirms the notion that if utilised intelligently, research can empower institutions with appropriate skills on curriculum and assessment alignment strategies. Through systematic research plans, institutions can align research outputs with tuition, thus ensuring a 'thermotaxis' between educational policies and classroom practices. This would further enhance the utility value of the research logic as an integral part of policy formulation and decision making strategy.

Adopting Relevant Curriculum Policy and Assessment Practices

Curriculum policies are not cast in stone. They are a result of some ferocious dialogue and contestations among different stakeholders on the quality of envisaged educational systems. Curriculum deliberations too are a result of what Archer (1992) terms a decade of globalisation and its concomitant impact in institutional domains like science and technology, politics, economics and culture. Both Archer (1992) and Finegold et al (1993) view globalisation as 'a multi-faceted process' characterised by the principle of interconnectedness and flexible policy borrowing across countries. The adoption of educational policies and systems is a complex process that requires planning and access to resources to make systems functional. Educational systems are not cast on stone. They are a consequence of contestations and trade-offs between various role-players. South Africa is a typical example regarding the genesis of educational transformation.

For South Africa, 1994 signifies the end of apartheid legacy and beginning of an arduous struggle to attain educational transformation and curriculum reconfiguration. The challenge to attain the envisaged paradigm shift in policy and praxis is littered with a plethora of policy documentations for instance, the National Education Policy Investigation (NEPI) (1990); ANC Policy Framework (1994); the White Paper on Education and Training (WPET) (1995) and the NQF Curriculum Framework (1995). The cumulative impact of these policy documents reflects South Africa's commitment to an integrated approach to education and training. Commenting on the impact of the WPET, Christie (1997:111) argues:

> *In responding to the need for change, the WPET brings together a set of proposals to restructure the relationship between education and training, to introduce greater flexibility of structures, to enhance mobility between learning contexts, and to build quality on 'the scaffolding' of a National Qualification Framework. Together, these proposals aim at a policy of 'life-long learning', which would widen access to education and training as well as link it to human resource development policies.*

The cumulative wisdom alluded to above, is succinctly elaborated by Nkomo (1998:137):

> *Education is a process by which we seek to achieve the maximum enlightenment possible. This is accompanied by emancipating the individual (through the promotion of the realisation that there exists within one the capacity to transform one's circumstances) and by extension society, from ignorance, prejudice of all forms, parochialism, poverty and so forth.*

The resonance of Nkomo's thesis consolidates explicitly the cumulative rigour that curriculum and assessment synergy bears on educational systems and practices. It is essential therefore, to create conditions that would enhance alignment of educational systems.

Conclusion

The dictum *'Keep your eyes on the shifting curriculum discourse'* seems to be an appropriate summation of the thesis of this paper. By being at the cutting edge of both the curriculum and assessment discourse, institutions of learning will be better equipped to interrogate the current educational policies and practices. It would further enhance the possibilities for institutions of learning to maximise their efforts in ensuring a better alignment between curriculum policy and assessment practices.

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Editor's Note: In the March Journal, Rory McGreal and his team reported on the eduSource project, a collaborative venture among Canadian public and private sector partners to create the prototype for a working network of interoperable learning object repositories. This paper describes The University of Mauritius Learning Object Repository (UoM LOR) based on Learning Object Metadata (LOM).

Reusable Learning Objects Aggregation for e-Learning Courseware Development at the University of Mauritius

Mohammad I. Santally, Mahen Govinda, and Alain Senteni

Keywords: e-Learning, reusable learning objects, adaptation, online learning, distance education, learning object repository, courseware authoring, web-based environments, personalization, cognitive styles.

Abstract

Learning objects describe any chunk of *decontextualized* learning information, digital or non-digital, such as an image, text, video, educational game or sound files. The aim of those entities is to provide a tremendous set of learning knowledge that once developed can be exchanged among organizations, and be used to build individual lessons and courses. We present in this paper, the learning object repository project of the University of Mauritius for online courseware development. The project consists of three main phases (1) Development of the repository, (2) Extension of the repository with a Course Builder tool and (3) Incorporation of adaptation features to courses built from combination of learning objects from the repository. Two phases of the project are already completed and we explain the major concepts and approaches behind these projects and argue the need for extending the capabilities of the course builder tool to include adaptation features for personalized learning.

The Concept of Reusable Learning Objects (RLOs)

Learning objects describe any chunk of *decontextualized* learning information, digital or non-digital, such as an image, text, video, educational game or sound files. The aim of those entities is to provide a tremendous set of learning knowledge that once developed can be exchanged among organizations, and be used to build individual lessons and courses (McGreal & Roberts, 2001). The key factor for this flexibility is not performed by the physical learning object itself but by its standardized description or more precise in metadata specification (Rumetshofer & Wöß, 2003). As cited in IEEE (IEEE, 2002) Learning Object Metadata (LOM) specification:

> *A metadata instance for a learning object describes relevant characteristics of the learning object to which it applies. Such characteristics can be regrouped in general, life cycle, meta-metadata, educational, technical, rights, relation, annotation, and classification categories.*

Learning objects are often used as components to assemble larger learning modules or complete courses, depending on different educational needs. Assembling of these learning objects is also known as *content packaging* and provides a standardized way (metadata standards) to exchange digital learning resources between different learning systems. Packaging of learning objects of low granularity (for example, a web page) into larger granularity objects (such as a chapter) is similar to the *lego bricks* approach that provides children with a set of *decontextualized* small granularity objects. Children assemble (*contextualize*) the relevant bricks to form, say a model of a house. Using learning objects to construct sections, chapters of modules, and eventually curriculums, is analogous to the lego bricks approach (figure 1.0).

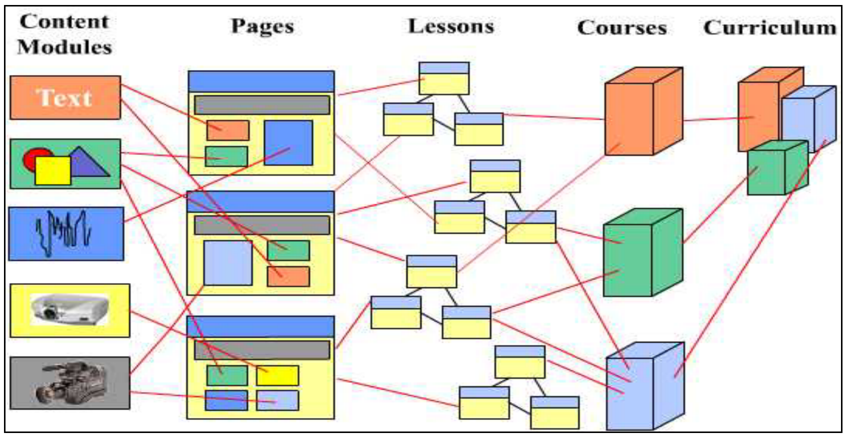

Figure 1.0: From Learning Objects to complete Curriculum: The Lego Metaphor

The concepts of reusability and contextualisation gives rise to what is called the *reusability* paradox. The reusability paradox postulates that the more you contextualise learning objects, the less reusable they become and vice versa (figure 2.0). A constraint governing this paradox is that contextualisation, as postulated mainly by contemporary learning theories, is critical for successful and meaningful learning to occur. The size of a learning object fits with the context-reusability constraint imposed by learning objects. Wiley *et al*. (2000) noted the inverse relationship between the size of a learning object and its re-usability. As the learning object's size decreases (lower granularity) its potential for reuse in multiple applications increases.

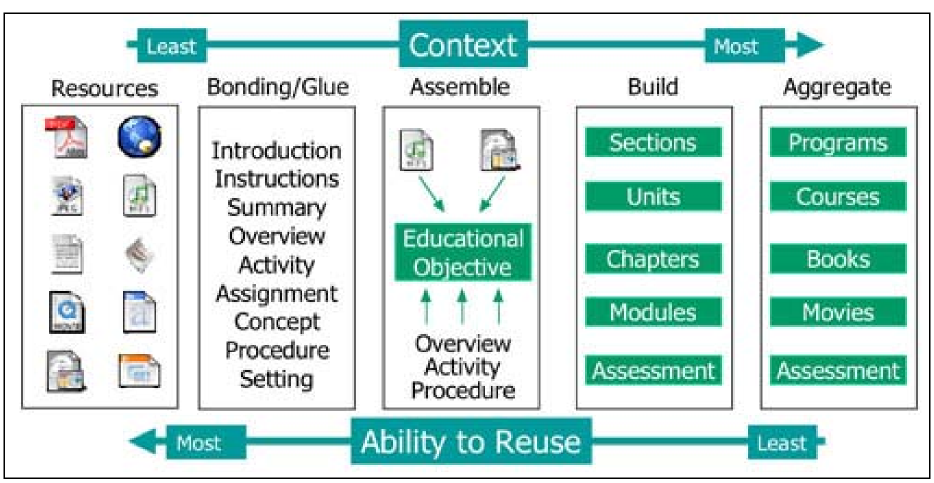

Figure 2.0: Context v/s Reusability (Hodgins, 2000)

Content and context must therefore be captured independently, but context and good pedagogy must be introduced through the learning design process. Dufresne et al. (2002) postulate that it is imperative that the resources be created separately from their intended context to promote reusability, and separately store the documents and their use in scenarios. They also highlight the importance of linking the objects not only to their metadata, but also to explicit documentation on the theoretical and practical aspects of their possible uses. To sustain such statements, the authors recognize it is important to develop of appropriate tools to implement the proposed solutions.

The University of Mauritius (UoM) Learning Object Repository (LOR)

Rationale behind the UoM LOR Project

The University of Mauritius launched its virtual campus in 2002 with an e-Learning platform, Virtual-U developed at the Simon Frasier University with about five online and web-enhanced modules that were delivered to approximately five hundred students. The University of Mauritius set itself four main objectives with the setup of its virtual campus namely:

- **Institutional Framework and Resources**
  Provide a framework in which a range of educational resources and technologies are available to staff and students to enable more flexible approaches to teaching, learning, and learning environments.
- **Training and Knowledge Building**
  Train and build capacity through staff development activities for academic and support staff to implement a range of learning methods and appropriate technologies. Support a shift to new methods in the educational practices in place at the University and the workplace by involving academic staff in the use of these methods and technologies for their own knowledge building.
- **Pedagogy and student support**
  Develop new student-centred models of learning, learning environments, and pedagogies to better meet the needs of the workplace, society and the Mauritian learner.
- **Content Development**
  Produce high quality academic e-learning materials, online learning resources and other relevant materials in conjunction with the delivery of courses on a distance education and flexible learning mode.

The motivation behind development of a learning objects repository at the University is inherent from the objectives that were set and the project is viewed from a perspective of providing the blueprint to lay the foundations of the institutional framework for sharing and exchange of resources in Mauritius and the external world.

Metadata Standards and Need for adaptation to the Local Context

Standards are necessary for internetworking, portability and reusability. With standards, there is no confusion about what is being communicated by a particular expression. There are many standards in the literature such as ARIADNE (Alliance of Remote Instructional Authoring and

Distribution Networks for Europe), DUBLIN CORE, IMS and LOM (Learning Object Metadata). For the UoM LOR project, LOM was chosen to document the learning objects.

Learning object metadata keywords list were found inadequate from a local educational point of view. Consultation with the tertiary education commission (TEC) of Mauritius led to extension of the original keywords list of the LOM. We use the LOM standard to conserve the reusability and interoperability features of the UoM LOR with other repositories and the TEC keywords list is used for metadata exchange within the local context.

Context-independence and Reusability in UoM LOR

Dufresne *et al.* (2002) argue that the sharing of learning objects by geographically and/or culturally dispersed users and methods of (re)contextualisation of these objects, has not been fully explored. Explicit definitions, visualizations and pedagogical manipulation of the different utilization contexts of a learning object seem to be determinant attributes for success in sharing. While most courses in classic classroom environments are specifically designed for a particular goal and context, learning objects are actually electronic content that is usable in different contexts and situations.

In the UoM LOR, we add as part of the object metadata, two additional fields "comment" and "pedagogy" where different users can edit to add new usage contexts and pedagogical approaches that can be applied with a particular object in different situations (figure 4).

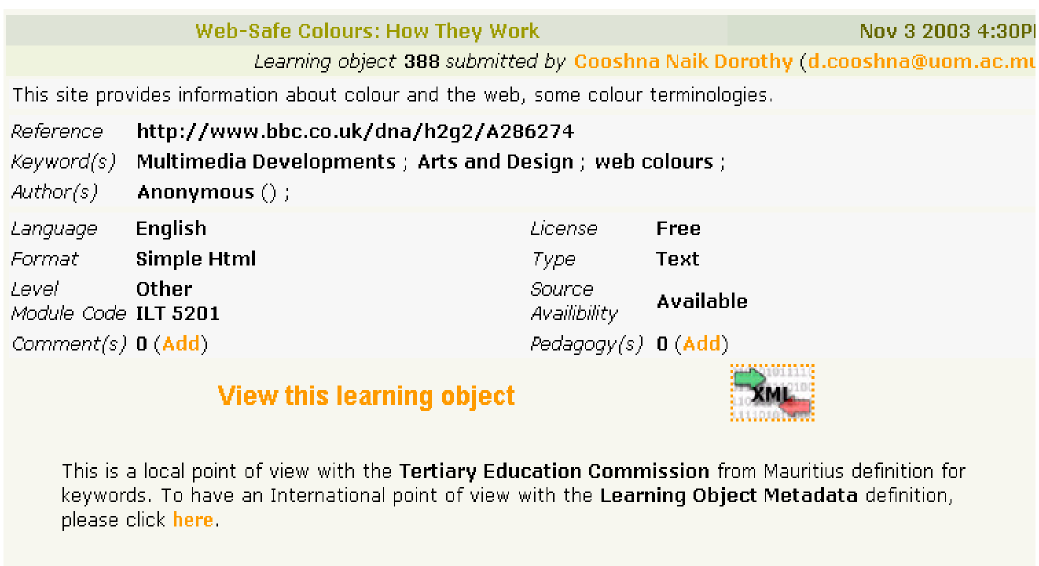

Figure 4.0: Separating Content and Context in the UoM LOR

The LOR Aggregator Tool

The LOR Aggregator tool has been developed as a second phase development and integrated in the UoM LOR interface as an extended functionality. The system consists of three main core parts:

- A user-friendly interface for the user (lecturer) to create a course, search for relevant learning objects and to add them to his course.

- Populate an XML document dynamically for each course that is the actual package of the course. A purely object-oriented system has been built and an XML database.
- Transformation of XML document through XSLT applications into HTML format so that other users can view it.

IMS Content Packaging Standard and Conceptual Model

The content packaging specification is aimed primarily at content producers, learning management system vendors, computing platform vendors, and learning service providers. The objective of the IMS Content Packaging is to define a standardized set of structures that can be used to exchange content. The scope of the IMS Content packaging specification is focused on defining interoperability between systems that wish to import, export, aggregate, and disaggregate packages of content (http://www.imsproject.org).

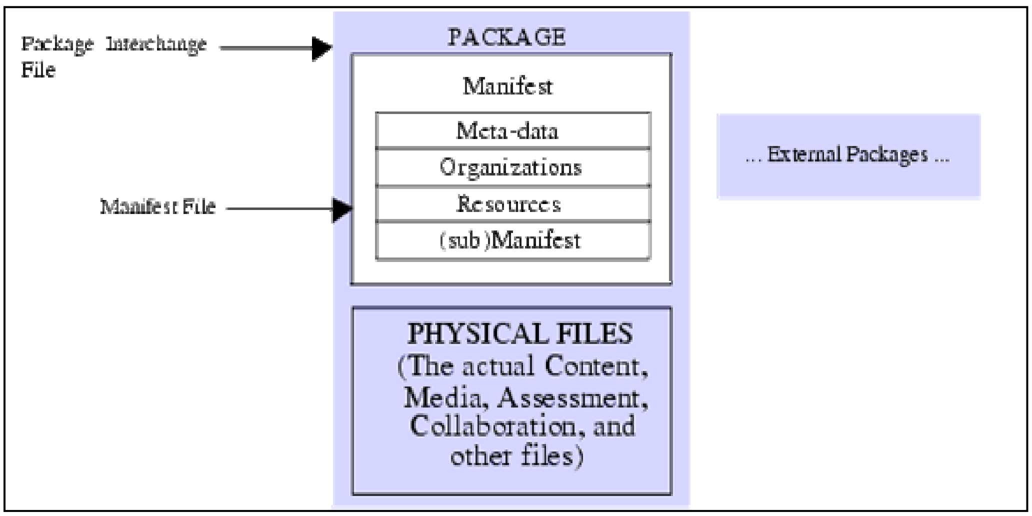

Figure 5.0: IMS Content Packaging scope
http://www.imsglobal.org

The IMS Package depicted in figure 5.0 consists of two major elements: a special XML file describing the content organization and resources in a Package, and the physical files being described by the XML. The special XML file is called the IMS Manifest file, because course content and organization is described in the context of 'manifests'. Once a Package has been incorporated into a single file for transportation, it is called a Package Interchange File.

Learning Objects Selection and Sequencing

According to the IMS Content Packaging Specification (IMS CP), a package without the manifest file is not considered as an IMS package. The manifest file is considered as the soul of the content package because it keeps information about the learning objects that are in the package (*a course folder*) and information about how the LOs are organized to provide a learning sequence. Adding a resource to the course being created can be done in three different ways:

- The lecturer uploads a LO from his machine to the course folder successfully
- The lecturer adds a public LO from the repository to the course folder

- The lecturer can add a private learning object (password) protected into the course folder.
- The lecturer can decide of the sequence each resource will be presented in the course file.

As depicted in the IMS CP specification, the organization or structure of the course is stored in the <organizations> element of the manifest document. The <organizations> element can contain one or more <organization> and the <organization> element will contain one or more <item> element where the latter may contain zero or more <item>. The <item> element will refer to the resources that in turn refer to the LOs in the course package. Therefore, for our system, we provide an interface that will give the lecturer the facility to add as many 'organizations' as he likes, add 'items' to those 'organizations' and add an 'item' to another 'item'. Finally, the updated manifest should conform to the IMS CP.

Overall Architecture

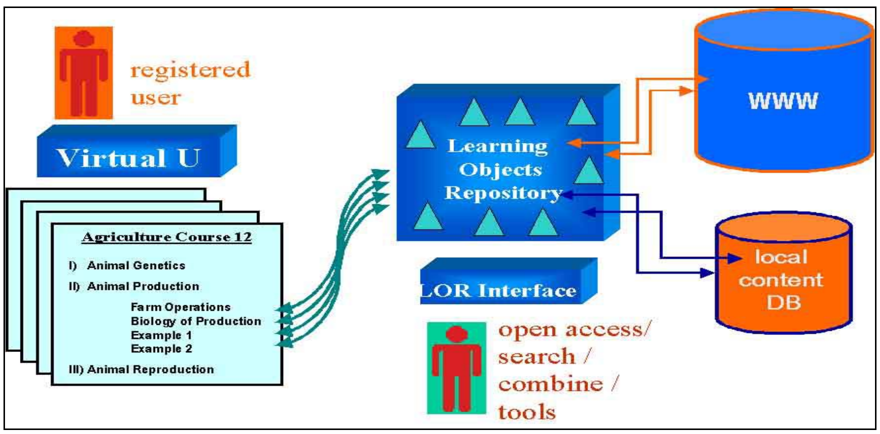

Figure 6.0: Integrated Architecture for LO Aggregation and the Virtual Campus

Discussion and Future Work

The Learning Object Repository project has provided considerable extensions and capability to the University of Mauritius virtual campus that is actually used to deliver online courses at the University. The virtual campus of the university lacked the main facility of courseware authoring and the learning object aggregation tool has provided for this facility. Learning objects can be aggregated together, and instructionally sequenced to meet the needs of the course and published on the virtual campus of the university. Figure 6 shows the integrated architecture for learning objects aggregation and publishing on the e-learning platform.

The learning objects approach means that components of courses and the learning objects themselves can be later reused in different contexts, courses or applications. However, there are a number of improvements that can be brought to the existing aggregator tool. For instance a drag and drop user interface is currently being developed for dynamically adding and removing learning objects from a course. In addition, simple zip functionality will be added so that courses will be available for download by students to enable offline browsing.

Important work in progress is phase 3 of the UoM LOR project that investigates the possibility of adding adaptation elements in the authoring of courseware through the combination of learning objects. It is postulated that one of the main problems with e-learning environments is their lack of personalisation (or adaptivity) (Cristea, 2003; Rumetshofer & Wob, 2003; McLouglin, 1999; Ayersman & Minden, 1995).

- Offering personalization in distance education systems via e-learning mode will help promote the teaching and learning process through customization of tutorials to each student based on his level of understanding, his academic ability and his individual learning, cognitive preferences, learning strategies and preferred information processing strategies (sequential or random).
- Cognitive styles are considered as important factors that need to be included in adaptive learning environments while modeling the user (Ford ,2000). Rumetshofer and Wöß (2003) propose the extension of the learning object metadata standards to include what they call "psychological" factors as part of a learning object metadata.

The phase 3 of the UoM LOR project deals with how to include these features while constructing the course itself. We are currently building a prototype extension to the aggregation tool using simple IF-THEN rules to incorporate adaptivity in the course to provide a personalized learning experience to the learner. Different learning paths will be available for different types of learners. For instance, one with a visual preference will be exposed to learning objects containing animations and simulations, visual cues or images while a student who is kinesthetic will be exposed to learning objects with same content but with more activities such as calculations and interactive exercises. When the course is being created, a lecturer will select learning objects matching different learners' styles for a particular topic. When a student logs in the system, his characteristics will be loaded from the stored student model and he will be presented with the suitable material. In the case that a learning object matching the students' preferences is not found, then the system will present the closest match to that student. We are currently investigating how to deal with such situations using fuzzy approaches.

Conclusion

Many learning object repositories have been built. All have the same goal: sharing of reusable, context-independent learning objects. But the question remains whether we are making optimal use of these repositories? How much sharing has taken place between the various repositories that exist? This is an open question. Obviously they are being used but we do not presently think that users are making optimal uses of these facilities. Our learning object repository has also been subject to the same problem and we are currently pushing the research towards new horizons such as adaptive courseware authoring from learning objects to offer personalization to students following online courses. This paper therefore summarizes the current developments at the University and describes our on-going effort to deal with the current issues such as under-utilization of repositories and lack of personalization in web-based learning environments.

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Editor's Note: In the March Issue, Jinan Fiaidhi published design issues in depth as they relate to teaching a programming language. RecoSearch combines aspects of subject matter and learning object searches with learning object recommender capabilities. It integrates content, collaboration, collaborative filtering and search techniques to increase the yield of relevant materials.

RecoSearch: A Model for Collaboratively Filtering Java Learning Objects

Jinan Fiaidhi

Introduction:

Digital repositories populated with learning objects are becoming popular tools in the creation of instructional technologies (Recker and Wiley, 2001). Many current efforts to facilitate the discovery and instructional use of learning objects (LOs) recommend the use of simple content-based search engine (e.g. ONES Project: Puusttjarvi and Poyry 2003) or the use of smart interface associated with learning object repositories (e.g. 4-Tier IBM Learning Interface: Dodani 2002). While both methods have their own advantages, they fail to filter useful learning objects in many situations (Recker and Walker 2000). However, as we argue in this paper, that by incorporating components from both methods with a LOs recommender system capabilities, one can overcome these shortcomings. In this paper, we present an elegant and effective model for combining content, collaboration, collaborative filtering and searching techniques in an integral engine that we call *RecoSearch*.

To achieve a working model prototype for our integration, we will restrict our application to filtering "Java Learning Objects" in a collaborative teaching environment. In this direction, the challenging aspect of teaching a programming course is how to provide the right information in the right context at the right time to the right person. The introductory object-oriented programming course (taught in Java) at Lakehead is made up of students who come from a variety of disciplines (computer science, mathematics and engineering) and have different levels of programming experience. For example, some have taken C++ with object first approach and some have extensive programming experience in C or another procedural language like Fortran 90. This audience has little conceptual understanding of multi-class programs, object oriented design, class methods, parameter passing, and inheritance. The first challenge in such introductory programming courses is to bring all students to a common learning environment within 3-4 weeks. One of the major problems of bringing students to the same level of understanding in a short period of time is the lack of an effective communication mechanism between instructor-student and student-student to share crucial knowledge at the right time. Students often misunderstand concepts and thus apply them incorrectly; which leads to hours of wasted time spent on debugging logically incorrect code.

We believe that we can address some of these problems by creating our RecoSearch environment. We will focus in this environment on two aspects:

- presenting key Java programming concepts by utilizing learning objects;
- establishing a collaborative platform for discussions, searching, recommending and exchanging Java learning materials.

Addressing the first aspect, we need to make sure that all course related material is organized into a repository of information objects. The key components of the repository are textbook content, Java source code examples and review questions. Then instructors can create learning objects using the repository of information objects; and share them with colleagues and students. In the long run, this will lead to a library of learning objects to which instructors can make contributions, as well as use publicly available learning objects in their own courses.

Addressing the second aspect, we need to make certain that all knowledge components are assembled under one collaborative environment. We will achieve this through creating a collaborative environment that employs at least two XML messenger channels (one for sending JLO and the other for users chatting). The description of such collaborative environment has been explained in our earlier article (Fiaidhi and Mohammed 2004). However, our ultimate future goal to link this collaborative environment to the POOL of learning objects (Hatala and Richards 2002) utilizing the JXTA APIs (www.jxta.org). This collaborative environment will serve in various ways, including a) it will allow instructors to create and share customized content to meet the learning objectives of individuals or groups; b) it will allow students to create personalized learning profiles and share them with others; c) it will create an environment where students can discuss course-related java programming material in its own context. Figure 1 illustrates the main components considered by the RecoSearch model.

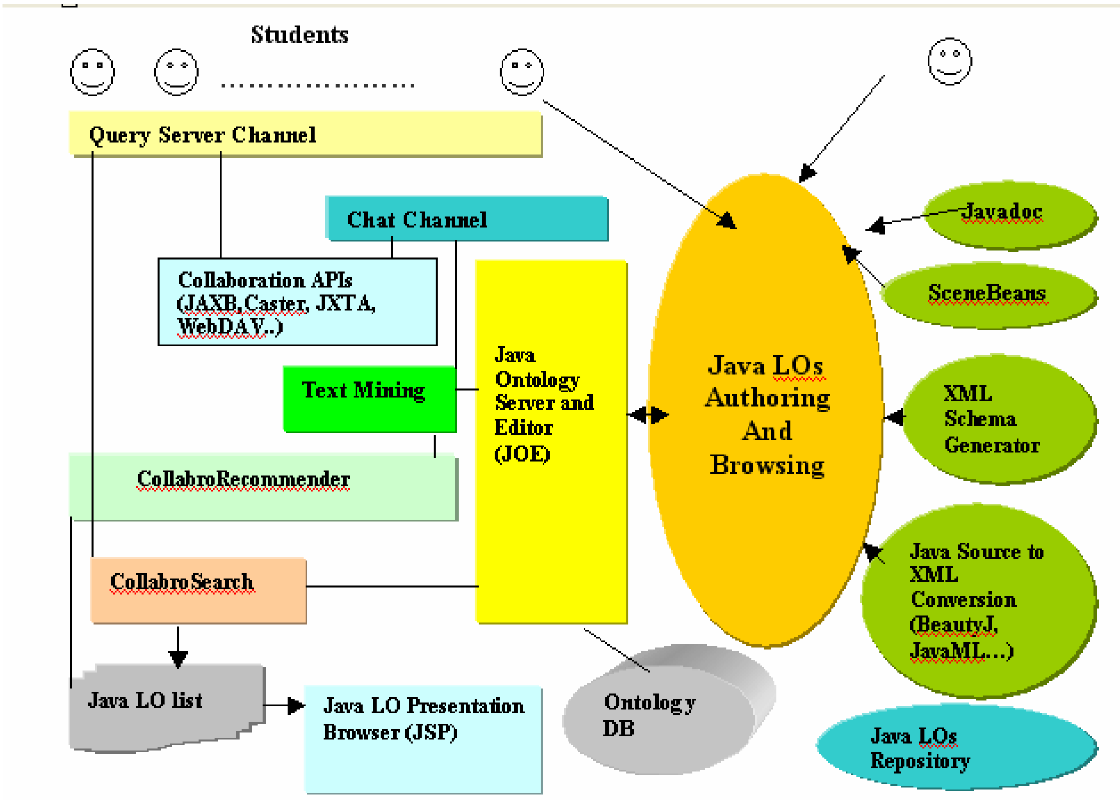

Figure 1: The RecoSearch Model Components

The features of this model will be described in the next sequel. However, we would like first to shade the light on why having only a single search engine or recommender engine is not effective for searching relevant learning objects.

The Problems of using Pure LOs Search Engines:

There are presently countless Learning Objects available for corporate and academic use. Table 1 list few of such notable repositories.

Table 1:

Notable LOs Repositories.

Repository Name	URL Reference
eduSource	http://edusource.netera.ca
Splash	http://edusplash.net
MERLOT	http://www.merlot.org
CAREO	http://careo.netera.ca
ESCOT	http://www.escot.org
EOE	http://www.eoe.org
GEM	http://www.thegetway.org
IDEAS	http://ideas.wisconsin.edu
LRC	http://wwww.edlrc.unsw.edu.au

Despite the advantages of having access to such ever-growing object libraries, E-learning paradigm now faces a more pressing challenge: how to find the most appropriate learning object for a given user/purpose? Indeed, there are many different ways in which to locate material in a Learning Object repository. *Searching* and *browsing* are two obvious methods but the value of these methods depends on the information and organizational structure or standard of the repository. On one hand, browsing represent the ability to explore through categories and see all that is on offer in each category. This is the "discovery" mode in which unknown nuggets are often uncovered. If a repository has many objects, say 10,000 or more, the classification categories need to be well structured and extend several layers deep to enable each component of the classification "tree" to contain a manageable number of objects. General classification categories, or taxonomies, are widely used in libraries (e.g. the Dewey system or National Library of Congress system) but many subjects also have much more detailed subject-specific taxonomies. These taxonomies are essential tools for people browsing through repositories. In contrast to a library full of books, where the physical book can only sit on one book-shelf, learning objects repositories can have a single asset represented at many different locations in the taxonomy. This means that many different browsing approaches can lead to the discovery o f suitable objects. One problem with browsing is that it can be time-consuming. Imagine how much more effective it would be for each person using the repository to define their own taxonomy and "store" learning objects in the context that means most to them - locating these objects again and again would be simple.

On the other hand, searching is often based on keywords or the use of metadata tags. This works well if the search is concerned only with the content of the material. Keyword searches can be expanded to include the text of the material itself. The true power of searching is enabled when objects in the repository include metadata description. Library Science has long recognized this type of searching as the old-fashioned card indexes which have been given way to computer-based records using one of several established standards to describe published works/objects. Learning objects require considerably more metadata details concerning how the material may be used: the type of resource, who might learn from it, in which context they might learn from it, age or experience of expected learner, typical time required for learning, and many more. There are many standard specifications, such as IMS and ADL, IEEE standard Learning Object Metadata (LOM), and CanCore which uses as many as 70 fields/tags to describe and classify learning objects. Searching becomes even more powerful when each specific metadata field is used. Another mode of searching a digital repository is by means of a software agent. In this case a computer application, such as an LCMS or another digital repository, interrogates the digital repository based on some defined query. The results of the query are returned through the application, which initiated the query using any query processing language (e.g. XML schema, XQuery, XPath, XQL, XML-QL, QUILT). Moreover as the granularity of the learning objects decreases and as the size of repositories increases, there will also be a need for much more fine-grained topic descriptions than any standard can provide. Even advanced searches can overwhelmingly return hundreds of thousands of results (Gaaster 1997).

However, searching for LOs within heterogeneous repositories is a far more complicated problem. In searching for such LOs we *must first decide on appropriate metadata scheme. But which one*! Typically, these learning objects may be lesson content stored as text, audio-visual or interactive media files, or simply learning activity templates expressed in a learning design format. Despite their apparent ubiquity, the locating and re-use of LOs is hampered by a lack of coordinated effort in addressing issues related to their storage, cataloguing and rights management. Strident efforts have been made to create portal repositories by communities such as CANARIE, Merlot, SMETE and CAREO. Not surprisingly, each entity produces a rather individual reflection of its own perceived organizational needs, and the concept of making all these repositories work together while laudable, has received less attention. More recently, the E-learning community has been focusing on the ability to connect and use resources located in distributed and heterogeneous repositories. This process closely resembles the initiatives in the domain of digital libraries, to the extent that there are initiatives such as the POOL, NSDL, IMS DRL, eduSourceCanada, and the OKI projects, for connecting different types of LOs repositories as well as the traditional digital libraries networks (Hatala and G. Richards, 2002). This will provides us with an effective searching infrastructure when creating such large and open networks. Unfortunately these efforts are just at their initial stages and require huge resources and synchronizations to be mature.

Overall, the traditional search process within single or heterogeneous LO repositories may prove to be inadequate in a society that demands immediate, reliable results in order to meet the demands of their customers. What we argue in this article is that one can alleviate such problems by trying to collaboratively "predict" what users will want rather than expect them to completely define their needs through searching parameters only.

Problems using Pure LOs Recommender Systems:

Recommender systems (RS) (Resnick and Varian 1997) suggest information sources and products to users based on learning from examples of their direct likes and dislikes or from their collaborative or group previous preferences. Unfortunately such systems are rarely used for recommending LOs, but they are widely and successfully used in many other online systems (e.g. in amazon.com) to suggest items that users may "find interesting". The RS recommendations are generated using two main techniques: *content-based*, and *collaborative filtering*. Content-based systems require manual intervention, and do not scale to large item bases. Using such technique users are required to specify their preferences explicitly and in detail, this process can become so tedious or impractical that the system is essentially inaccessible to some users. However with collaborative filtering (CF) (Goldberg et al, 1992) systems do not depend on the semantics of items under consideration; instead, they automate the recommendation process based solely on other user opinions. This is the most interesting point in CF where their algorithms doesn't need a representation of the items in term of features but it is based only on the judgments of the user community. Because of this, CF can be applied to virtually any kind of item or object: papers, news, web sites, movies, songs, books, learning objects, locations of holidays, stocks. Since CF techniques don't require any human intervention for tagging content, they promise to scale well to large item bases.

While CF algorithms are promising for implementing large-scale recommender systems, they have their share of problems. The problems with pure CF systems can be classified in three domains: problems affecting new user start up, sparsity of useful information for existing users, and relatively easy attacks on system correctness by malicious insiders (Hayes et al, 2002).

Java Learning Objects: Authoring, Packaging and Presentation

Java learning object (JLO) can be defined as an integrated module containing the core text, code examples, review questions, supplementary material, and Java programming lab exercises. The traditional standard format used for representing Java source code as well as its related materials is plain text-based. However, the basic shortcoming of the plain text format is its "flatness", the absence of almost any explicit structure. A free-form plain text document represents a series of tokens, where every token is a simple character string. Any structure required by the programming language has to be coded into the relationships between such tokens. This structure becomes apparent only after a rather sophisticated and complicated process of parsing. On the other hand, the XML document model has inherent hierarchical structure easily designed to accommodate any structure including Java source code constructs. For this particular reason, learning object is uniquely described by an XML document that includes metadata and semantic relationships between LO components. The XML document also serves as an interface for future search and retrieval of LO's. Moreover, the LO will provide an open interface for a connection to other components, such as external assessment engines.

Each LO complies to a standard metadata format. However, most of the academia uses the CanCore standard (Friesen 2002), which will assure the intercompatibility and reusability among most of learning platforms. CanCore is an emerging standard for creating, sharing and extending learning objects independent of the platform or the audience and used widely by most of the academic institutions in North America. Each LO is editable and can be tailored (by creating a learning profile) to meet the needs of an individual student or a group of students. Learning object profiles (or *schema/DTD*) then will be distributed to students as email attachments or can be placed in a course management system for easy downloads. Learning object profile is a relatively small XML document that describes the components within the learning object. The XML Schema is a valuable concept which enables you to define your own *XML vocabulary.* An XML vocabulary is an industry-specific XML information model or document type that you define for XML data sharing. In other words, you define constraints that specify what a particular group of XML documents should always look like. Document creators, programmers, graphic designers, and database specialists use a constrained document type as the basis for creating compatible application pieces. You can define an XML vocabulary by constraining your XML file. Figure 2 illustrates a simple Java source code and its equivalent XML and Schema.

```
import java.applet.*;
import java.awt.*;
public class FirstApplet   extends Applet {
  public void paint(Graphics g) {
    g.drawString("FirstApplet", 25, 50);
  }
}
```

– – – – – – – – – – - (a) Java Source Code – – – – – – – – – – – – –

```
<java-source-program>
<import-declaration>import java.applet.*;
  </import-declaration>
<import-declaration>import java.awt.*;
  </import-declaration>
<class-declaration>
<modifiers>public</modifiers> class
  <class-name>FirstApplet</class-name>  extends  <superclass>Applet</superclass> {
 <method-definition>
  <modifiers>public</modifiers>
      <return-type>void</return-type>
    <method-name>paint</method-name>
     (<formal-arguments>
        <type>Graphics</type>
        <name>g</name>
      </formal-arguments>)
    <statements>{
    g.drawString("FirstApplet", 25, 50);
  } </statements> </method-definition>
}
</class-declaration>
</java-source-program>
```

– – – – – - (b) XML equivalent code – – – – – – – – – – – – – – – -

```
<?xml version="1.0" encoding="utf-16"?>
<xsd:schema attributeFormDefault="unqualified" elementFormDefault="qualified" version="1.0"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
 <xsd:element name="java-source-program">
  <xsd:complexType>
    <xsd:sequence>
    <xsd:element maxOccurs="unbounded" name="import-declaration" type="xsd:string" />
      <xsd:element name="class-declaration">
        <xsd:complexType>
          <xsd:sequence>
            <xsd:element name="modifiers" type="xsd:string" />
            <xsd:element name="class-name" type="xsd:string" />
            <xsd:element name="superclass" type="xsd:string" />
            <xsd:element name="method-definition">
              <xsd:complexType>
                <xsd:sequence>
                  <xsd:element name="modifiers" type="xsd:string" />
                  <xsd:element name="return-type" type="xsd:string" />
                  <xsd:element name="method-name" type="xsd:string" />
                  <xsd:element name="formal-arguments">
                    <xsd:complexType>
                      <xsd:sequence>
                        <xsd:element name="type" type="xsd:string" />
                        <xsd:element name="name" type="xsd:string" />
                      </xsd:sequence>
                    </xsd:complexType>
```

```
            </xsd:element>
            <xsd:element name="statements" type="xsd:string" />
           </xsd:sequence>
          </xsd:complexType>
         </xsd:element>
        </xsd:sequence>
       </xsd:complexType>
      </xsd:element>
     </xsd:sequence>
    </xsd:complexType>
   </xsd:element>
</xsd:schema>
 – – – – (c ) Equivalent  XML Schema – – – – – – – – – – –
```

Figure 2: FirstApplet.java converted to XML and XML Schema.

Fortunately, all Java source code comply to the same syntactic schema as defined by the Javadoc. One can use the Javadoc™ plug-in with the XXE editor (http://webdesign.about.com/cs/software/gr/aapr-xxe.htm) to directly convert the Java source file on the fly to an equivalent XML file formated with the standard Javadoc tags. In this case, no schema validation will be required. However, there are many other dedicated tools and APIs for this that can be used to used any to convert Java source files into XML format (e.g BeautyJ (http://beautyj.berlios.de/), Jato API (Krumel 2001), and JavaML (http://www.cs.washington.edu/homes/gjb/JavaML/)) but without the use of the Javadoc plug-in. In this case, one need to validate the XML schema with the XML file generated. The designer can generate XML Schema for any typical XML file format using simple tools as the XML Schema Generator (http://www.xmlforasp.net/CodeBank/System_Xml_Schema/BuildSchema/BuildXMLSchema.aspx) and then uses a simple program as the one displayed in figure 3 to validate the given XML file with the schema generated.

```
import org.w3c.dom.*;
import org.apache.xerces.parsers.*;
import org.apache.xerces.dom.*;
import org.xml.sax.*;
import java.io.*;
import java.util.*;
import javax.xml.parsers.*;
public class TestValidator {
   /** Creates a new instance of TestValidator */
   public TestValidator() {
   }
   public static void main(String[] ar)
   {
      try
      {
         DocumentBuilderFactory dbf = DocumentBuilderFactory.newInstance();
         dbf.setValidating(true);
         dbf.setAttribute(
         "http://java.sun.com/xml/jaxp/properties/schemaLanguage",
         "http://www.w3.org/2001/XMLSchema");
         DocumentBuilder db = dbf.newDocumentBuilder();
         Document doc = db.parse("C:\\new.xml");
      }catch(Exception e)
      {
         System.out.println("Exception: "+e.getMessage());
      }
   }
}
```

Figure 3: A Java Program to validate the XML file against given XML Schema.

The BeautyJ, JavaML and Jato API are all open-source which can be downloaded and incorporated with any Java-based application environment. There are many advantages of using these packages/APIs over directly employing traditional Java XML APIs such as JDOM, SAX, XSLT or DOM(Simic and M. Topolnik 2003). With such packages/APIs, developers simply express the XML elements that map from specific Java Source. Their packages/APIs interpreters then implement the necessary parsing and generation algorithms to accomplish the desired actions. As such, you avoid the monotonous, monolithic, and difficult-to-maintain XML parsing and generation code using the mentioned traditional Java XML APIs.

Binding Java Source Expressed in XML to Java Objects:

Currently XML and Java technology are recognized as ideal building blocks for developing Web services and applications that access such services including eLearning systems built upon learning objects. But how do you couple these two technologies in practice? More specifically, how do you access and use an XML document (that is, a file containing XML-tagged data) through the Java programming language? One way to do this, perhaps the most typical way, is through parsers that conform to the Simple API for XML (SAX) or the Document Object Model (DOM). Both of these parsers are provided by Java API for XML Processing (JAXP). Java developers can invoke a SAX or DOM parser in an application through the JAXP API to parse an XML document – that is, scan the document and logically break it up into discrete pieces. The parsed content is then made available to the application. In the SAX approach, the parser starts at the beginning of the document and passes each piece of the document to the application in the sequence it finds it. Nothing is saved in memory. The application can take action on the data as it gets it from the parser, but it can't do any in-memory manipulation of the data. For example, it can't update the data in memory and return the updated data to the XML file. In the DOM approach, the parser creates a tree of objects that represents the content and organization of data in the document. In this case, the tree exists in memory. The application can then navigate through the tree to access the data it needs, and if appropriate, manipulate it.

Now-a-days developers have another Java APIs at their disposal that can make it easier to access XML documents: Java Architecture for XML Binding (JAXB). (http://java.sun.com/xml/jaxb/), Caster (http://www.castor.org/), and the JiBX (http://jibx.sourceforge.net) which provide APIs and tools that automate the mapping between XML documents and Java objects. It makes XML easy to use by compiling an XML schema into one or more Java technology classes. The combination of the schema derived classes and the binding framework enable one to perform the following operations on an XML document: (1) unmarshal XML content into a Java representation; (2) access, update and validate the Java representation against schema constraint; (3) marshal the Java representation of the XML content into XML content. However, marshaling a Java object means converting it to XML format for storage or for sending, and turning an XML document back into useable Java objects is called unmarshaling. *Figure 4 illustrates the JAXB architecturefor binding XML files into Java Objects*.

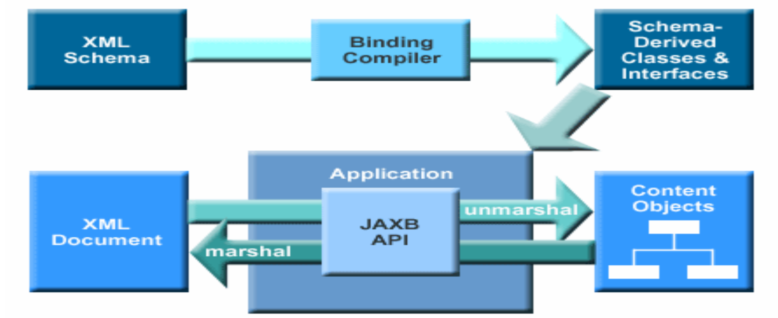

Figure 4: The JAXB XML Binding Architecture.

The immediate advantage of JAXB, Caster, and JiBX is that it provides a layer of abstraction that enables developers to quickly and conveniently work with XML documents such as the learning objects.

The Collaborative RecoSearch Approach:

Converting Java source code learning objects to XML and having the ability to paring it using sophisticated APIs like JAXB will not solve primarily the problem of searching and recommending LOs to learners especially in a collaborative and distributed environments. Even the use of the SCORM (the Sharable Content Object Reference Model developed by ADL http://www.adlnet.org/) which is the standard that is supported by the large e-learning players that supposedly ensures that learning content level This would obviously be a very good thing, but the problem is that SCORM emerges from the world of learning content management systems, so the emphasis is on how content is presented to individual learners and how individual learners' paths through a course can be sequenced and tracked - not on how learners and teachers can work together to create new knowledge. Hence there is a pressing need to develop extensions to SCORM which can support the following issues:

- Support for *distributed, collaborative development* of consensus ontologies. This should include schema integration and merging similar ontology with slight lexical differences.
- *Metadata.* The ability to create, remove, and query information about LOs, such as its author, creation date, etc according to one acceptable standard like CanCore.
- *Name space management.* The ability to copy and move LOs, and to receive a listing of LOs at a particular hierarchy level (like a directory listing in a file system).
- *Overwrite prevention.* The ability to keep more than one person from working on a LO at the same time. This prevents the "lost update problem" in which modifications are lost as first one author, then another writes their changes without merging the other author's changes.
- *Version management.* The ability to store important revisions of a LO for later retrieval. Version management can also support collaboration by allowing two or more authors to work on the same LO in parallel tracks.
- *Relevant LOs Recommendation*. This ability to recommend relevant LOs from the relevant previous queries of other users.

Some of the above issues are related to the creation of a LO based collaborative environment. In this direction one can use the standard WebDAV based toolkits developed by the Internet

Engineering Task Force (IETF) during early 1998 (Whitehead and Wiggins 1998). However, packaging LOs and publishing it on any user machine is yet another service to be added to these toolkits. In this direction we recommend the use of SceneBeans as a model for packaging Java-Based LOs (Fiaidhi, Mohammed, Sisko 2004) or simply use a JSP-Based LO publishing toolkits developed by Sun Microsystems (java.sun.com/products/jsp/docs.html).

The other two issues are related to designing two engines that can work simultaneously to search and recommend relevant or related LOs within a collaborative and distributed environment. We call these two engines as CollabroSearch and CollabroRecommender. The design issues related to these two engines are provided in the following two sections.

The CollaboSearch Engine:

Many researchers believe that searching for XML-Based learning objects within a single repository should be straightforward via searching for a matching metadata. This believe came from the fact that XML is a form of a database(Rizzolo and Mendelzon 2001) and hence searching for an XML metadata should be as easy as querying a database. According to such believe, many organizations developed various searching engines for the XML databases of documents(e.g. Amberfish, IXIASOFT, Infonyte Query, XML Query Engine, Tamino, MLE, Ultraseek, SIM, X-Hive, Xdirect, Xset, fxgrep, Xtenint, and Lore). As a "database" format, XML has some advantages. For example, it is self-describing (the markup describes the structure and type names of the data, although not the semantics), it is portable (Unicode), and it can describe data in tree or graph structures. It also has some disadvantages. For example, it is verbose and access to the data is slow due to parsing and text conversion. Actually an XML document is a database only in the strictest sense of the term. On the plus side, XML technology provides many of the things found in databases: storage, query languages, programming interfaces, and so on. On the minus side, it lacks many of the things found in real databases: efficient storage, indexes, security, transactions and data integrity, collaborative access, triggers, queries across multiple documents, and so on. For this purpose, many surrounding technologies have been developed for treating XML documents as a database management system DBMS (e.g. DTD, XML schema, XQuery, XPath, XQL, XML-QL, QUILT). However, none of such technologies are readily designed to deal with collaborative and distributed searching. There are two major issues related with searching for collaborative and distributed environment: The *schema integration* and the *collaborative ontology*.

Searching for LOs within heterogeneous repositories as well as within collaborative repositories is far more complicated problem. In searching for such LOs we *must first decide on appropriate metadata schema, but which one*! However, the most notable approach available today for extracting information out of various learning object with different source schemas is based on *schema integration/matching* techniques. Schema matching is an operation that takes two schemas as input and returns a mapping that identifies corresponding elements in the two schemas. Schema matching and integration is a critical step in many other applications: in eBusiness, to help map messages between different XML formats; in data warehouses, to map data sources into warehouse schemas; and in mediators, to identify points of integration between heterogeneous databases. Although the techniques used for schema matching includes variety of mechanisms(E. Rahm, and P. A. Bernstein 2001) (e.g. linguistic matching, machine learning, structural match, constraint match, and hybrid matchers), only the simple linguistic matching techniques are used (e.g. Cupid and SPHINX Systems). For the purpose of effectively matching schemas to extract information out of learning objects we find the most relevant type matching should be based on *semantic relationships* (Fiaidhi, Passi and Mohammed 2004). There are six semantic relationships defined in (Passi et al 2002) for schema integration – *identical*, *equal*, *equivalent*, *subset*, *unique*, and *incompatible*. Elements are *identical* if they have the same name and belong to the same namespace, since each namespace is unique and each element name within a given namespace is unique. Elements are *equal* if they have the same name and same definitions but belong to different namespaces. Elements are *equivalent* if they have different names but the same definitions. Elements with the same name, different namespaces, and the condition that the children of one element exist as a direct child group of the second element that is defined in terms of an *all* or *choice* satisfy the *subset* semantic relationship. Elements are *unique* if they have different names and different definitions that are not equivalent to the definition of any other element across all the local schemas. Elements with the same name, different namespaces and definitions that do not satisfy the subset semantic relationship are seen as *incompatible*. The above semantic relationships help identify matches and mismatches between elements and conflict resolution.

Collaborative ontology is the other key factor for enabling effective search in a collaborative and distributed environment. Normally, ontologies are normally built and maintained independently of each other in a distributed or collaborative environment. Therefore searching for LOs described by two different schemas, cannot be easily achieved because of the different reference ontologies (Klein 2001). Obviously, a solution to this problem requires the construction of an integral or collaborative ontology (Fiaidhi, Mohammed, Jaam and Hasnah 2003). There are many researchers who attempted to develop one general-purpose easy-to-use tools for creating, evaluating, accessing, using, and maintaining collaborative ontology such as Ontolingua(http://ontolingua.stanford.edu/). However, incorporating such one big tool in a learning environment that deals with Java LOs may impose several technical difficulties. In this direction, we find the use of several dedicated tools for editing ontologies such as Java Ontology Editor (JOE http://www.cse.sc.edu/research/cit/demos/java/joe/) and the JADE tool for ontology integration (http://gaper.swi.psy.uva.nl/beangenerator/content/main.php) is more effective to support our design objectives. Using the two mentioned tools, one can construct an *ontology server* that supports not only the development of ontologies by individuals, but also the process of achieving consensus on common ontologies by distributed and collaborative groups. The ontology server will provide many of the facilities that are crucial for promoting the use of ontologies for collaborative search including:

- Browsing and retrieval of ontologies from repositories.
- Assembly, customization, and extension of ontologies from repositories. This requires the ability to identify and resolve name conflicts and to augment descriptions of terms from the assembled ontologies. We may use for this purpose our *Fuzzy Similarity* algorithm which matches ontologies by considering their fuzzy lexical differences (Fiaidhi and mohammed 2004, Fiaidhi and Mohammed 2004a).
- Facilities for translating ontologies from repositories into typical application environments. We can use for this purpose translators that use for example CORBA's IDL representation (Mowbray and Zahavi 1995)
- Facilities for programmatic access to ontologies so that remote applications have reliable access to up-to-date term definitions.

One more issue that is particularly important for searching LOs within a collaborative and distributed environment is the ability to use indexed search. With indexed search the search engine search the collaborative index of all the LOs within the collaborative/distributed environment. This type of search prove to be be very fast (PCAI 2001). The final component of the CollabroSearch engine is the query server. This server must have the ability for searching collections of XML-based LOs beyond the capabilities found in both XML databases query languages or the simple SQL full-text search engine. The primary difference is in the retrieval mechanism. The LO query server Search, by contrast, should supports a rich query language which provides both sophisticated full-text retrieval and retrieval of highly-structured LOs. It should utilize both the collaborative ontology and the schema integration services as well as to be able to work in parallel with the CollabroRecommender engine. In this direction we are imagining a query server like the Dieselpoint (www.dieselpoint.com/) which can provide some of the required processing services besides providing a full range of linguistic tools, including a thesaurus, stemming, and a "Did you mean..." feature to alert users to possible misspellings.

The CollabroRecommender Engine

The CollabroRecommender is sort of filtering engine or a sort of recommender algorithm where the recommendations are based on a database of the users ontology ratings as opposed to content-based recommender algorithms that are based on the characteristics of the learning objects to be recommend. The basic principle behind such type of filtering is that clients must first share some information about themselves by rating some of the learning objects features they know, so that, in turn, they can get accurate recommendations based on the premise that users looking for LOs should be able to make use of what others have already found and evaluated. The current recommender systems provide tools for readers to filter documents based on which ones were read and liked (i.e. highly rated) by previous readers. Recommender systems based on automated filtering should predict new LOs for a user based on predictive relationships discovered between that user and other participants of a collaborative community. Most of the successful research and commercial systems in this area use a nearest-neighbour algorithm model for generating predictions. Such predictions that are based on the nearest-neighbour method work in three simple phases:

1. Users of a recommender system rate LOs that they have previously experienced.
2. The recommender then matches the user with other participants of the system who have similar rating patterns (i.e. they have similar opinions on experienced LOs.) This is usually done through statistical correlation. The closest matches are selected, becoming known as *neighbours* of the user, or collectively as the *neighbourhood*.
3. LOs that the neighbours have experienced and rated highly, but which the user has not yet experienced, will be recommended to the user, ranked based on the closeness of the neighbours to the user and the consistency of opinion within the neighbourhood.

From an algorithmic point of view, it is convenient to classify the recommender filtering algorithms in three classes depending on their query and update costs (Lemire 2004)*: learning-free*, *memory-based* and *model-based*. Obviously, there might be many types of operations that could be described as an update or a query, but we focus our attention on adding a user and its ratings to a database (update) or asking for a prediction of all ratings for a given user (query). We say that an operation whose complexity is independent of the number of users offers constant-time performance (with respect to the number of users). Essentially, the cheapest schemes are described as learning-free and have both constant-time updates and queries while schemes involving a comparison with users in the database are classified as memory-based and offer constant-time updates but linear-time queries, and finally the schemes requiring more than linear time learning or more sophisticated updates are said to be model-based. For purpose of this article, we are proposing a modified memory-based algorithm. The traditional memory-based algorithm requires us to go through a large set of preferences each time a prediction is required. This task can quickly become expensive: doubling the number of users, roughly doubles the response time of the system(Anderson et. al 2003). Ideally, one would want on-line constant time answers while using only a marginal amount of resources. As a more scalable alternative, we are proposing the use of the Bias From Mean algorithm (Lemire 2004). Given u an incomplete vector of ratings, the Bias From Mean scheme can be described by the formula:

$$P_{bias}(u)_i = \bar{u} + \frac{1}{card(S_i(\chi))} \sum_{w \in S_i(\chi)} w_i - \overline{w}$$

where $\bar{u}$ is the average of the incomplete vector and S_i(X) = {w 0 X: i 0 S(w)} where S(w) is the set of items rated in w and X is the set of all incomplete vectors available (all users). It can be computed much faster, without accessing the full database, and is only about 10% less accurate. It can be quickly updated when new ratings are entered and we only need to keep in fast storage a single vector.

The CollabroRecommender engine takes its input from the query presented by the requester to the CollabroSearch (or from the collaborative chatting text conveyed between the different users). In both cases, the text need to be mined for relevant terms using suitable *text augmentation* (i.e inferred information that is embedded in XML) and *text mining* preprocessors (i.e. infer information from the plaintext) with the aid of the collaborative ontology service mentioned earlier (see http://www.textmining.org/). The advantages of using mining techniques are:

- **To generate** critical metadata, such as names of persons, organizations, places, and other important data, enabling them to quickly and accurately access the key contents of LOs.
- **To organize** unstructured data into categories that reflect key learning areas and enable more effective and accurate searches and recommedations.
- **To exploit** unstructured data through the use of various analytical tools (e.g., OLAP tools) or visualization tools (e.g., link analysis tools), making use of the structured data provided.
- **To discover** new links and gain new insights into previously unanalyzed and untapped data.

The CollabroRecommender output is a list of LOs with their references.

Conclusions:

This article presented a flexible mixture model for searching and recommending Java learning objects. The model enforces a collaborative infrastructure for authoring, searching, recommending and presenting Java source code learning objects. The new model uses two specialized filtering engines which work simultaneously: CollabroSearch and CollabroRecommender to present relevant LOs from presented queries or from the mined text collected from the collaborative chatting channel between users. Experiments on Java source code testbed indicated that the proposed model is able to outperform any primitive collaborative environment that support some searching and discovery primitives such as the I-help system developed by ARIES Lab, Department of Computer Science, University of Saskatchewan (http://www.cs.usask.ca:7777/ihelp11/entrance.html) and any of the commercial collaborative environments such as JCE, Centra99, PaceWare, Grooves and Tango. The combination methods of the flexible mixture model (ReccoSearch) is rather preliminary. As a near future work, we plan to explore approximate searching techniques based on query expansion (Fiaidhi, Mohammed, Jaam, Hasnah 2003) as well as to explore different types of recommending algorithms (besides the k-nearest collaborative filtering that we originally used) such as the *Item-Based* recommending algorithm (Sarwar et al, 2001). The ultimate future goal of this research is to link the RecoSearch system to the POOL of LOs repositories(Hatala and Richards 2002) via utilizing the JXTA APIs (www.jxta.org/) to unable collaborators to search and recommend other LOs from the major repositories available to the academia.

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Editor's Note: There is a role reversal when industry becomes the center for research and academic institutions become followers rather than leaders. This paper from Najib Kofahi and N. Srinivas in Saudi Arabia analyses the relationship between software companies and organizations that have academic majors in Computer Science. It discovers ways to better serve the software industry and respond to rapidly changing needs. It suggests ways to collaborate more effectively in research and in training.

Computer Science Teaching and its Impact on the Booming Software Industry

Najib A. Kofahi and N. Srinivas

Abstract

This paper emphasizes the importance of computer science teaching. It mentions ingredients for strategic computer science teaching vital to cope up with rapidly changing technology within the software development organizations. It discusses present day computer science curricula and makes specific recommendations to fit curricula to current software industry needs.

Key words:

Computer Science; Computer Science and Automation; Computer Science Teaching; Curricula; Distance Education; Education; Knowledge; Knowledge Acquisition; Knowledge Analysis; Knowledge Presentation; SEI CMM; Software Development; Software Industry; Technology;

Introduction

PC-sized computers, cellular telephones, and fax machines are becoming as ubiquitous as radios and televisions. Microprocessors control household appliances such as washing machines, dishwashers and ovens. Modern information and communication technology [2, 5, 7] is playing a pivotal role in the economic well-being of many nations. This raises questions:

- How does the academic community react to this new reality?
- Are curricula keeping up with current changes and challenges?
- Does this influence the way we teach computer science?
- How does computer science teaching influence growth of software industry?

In response to rapid changes in computer technology, a new discipline is emerging that we call *Computer Science and Automation* (CSA). Apart from rapid pace of developments in this area [4, 6, 12], other important forces are at work that promote a need for frequent CSA curricula revisions. Change of CSA teaching style is needed [1, 3, 4, 6, 9, 12] to gain momentum to meet the competitive (software) job market.

Employers needs and required knowledge and skills for CSA careers continues to change rapidly. Preparation and motivation of students also faces major changes. These phenomena are not entirely new, nor are they confined to CSA. Educators faced such changes in the past and routinely responded with recommendations for model curricula for undergraduate and graduate programs [1, 8, 9]. Modification to CSA curricula/teaching is required to fit industry needs [3, 9]. Creating 'on-site training programs' for the (under) graduates in *Software Development Organizations* (SDOs) can show students the practical world while they are on learning curve.

This article explores 1) how to focus CSA teaching and curriculum to support SDOs growth, 2) the main ingredients involved in CSA teaching, 3) a vision of CSA teaching along with its associated directions, 4) the nature of work in the SDOs, and 5) effective CSA teaching to fit software industrial needs.

The Main Ingredients of CSA Teaching

It is difficult to enumerate all the ingredients underlying the CSA education. In this section we list some of the issues that have a major impact on the CSA education that influence the software industrial growth:

Knowledge Acquisition

To improve the CSA education, we specify *knowledge acquisition* (KA) from the students/faculty perspective, The KA focus for faculty is to improve relevance and quality of education in academic institutions. Emphasis from the student point-of-view is biased towards the job market. At this junction we do not stress creation of a research environment in academic institutions because of the small percentage of students who choose this option. Developing awareness of research among students is a bottleneck because research and innovation are focused in industry, not academic institutions. Industry research is cloaked in secrecy in the race to be first to market and secure a handsome return on investment. The academic/industrial relationship to share research information is becoming a no-man's map.

The dream of academic institutions is to lead surrounding industries through consultancy, new methodologies, quality control, and easy maintenance techniques. This scenario is not possible unless academic institutions update their KA process to gear up to the speed of industry. Knowledge available in textbooks and journals lags behind the requirements of industry. Courses must focus on application of current software tools and advanced techniques such as Object Oriented Programming (OOP). And they must be accessible through distance education and web based learning. For certain topics, such as e-marketing and tele-drafting, the KA should come from senior industrialists rather than advanced academicians and researchers. Partnership with industry is essential to ensure a vital and relevant curriculum.

Due to the rapid change in the field of computer sciences, the KA is changing its direction according to the industry needs. As a result, the learning curve in academic institutions varies dynamically. Teaching methodologies must also vary to achieve a consistent map between academia and industry. For example, course materials in CSA are focused towards programming concepts rather than the design methodologies. Replacement of the C programming language with Java in most academic institutions shows adaptation of leading edge technology. Electronic knowledge storage media and KA continue to change, and are replacing traditional approaches to learning based on text materials.

Knowledge Analysis and Presentation

Generally speaking, knowledge is a true justified belief. In the present context we look for the knowledge analysis from two different perspectives, viz., knowledge that supports the individual career and acquired knowledge that supports his/her application development. In both cases one needs the art and idea behind its representation.

In the first perspective, it is natural to think about it in a self-motivated way, where the knowledge is purely personal and narrow and initially absorbed as theory of "book learning".

The second perspective is more practical by nature, where application of one's learned knowledge matters a lot (usage for the real world application), rather than how much he or she has learned (quantity). Emphasis is moved from regurgitation of knowledge to applying this knowledge to real world situations in the form of physical objects.

The next phase of analysis of this knowledge is to determine its usefulness for software industrial growth. In teaching CSA, every teacher should know:

- What he/she should teach.
- What depth he/she should go in explaining the details.
- What applications are relevant, with exemplary case studies?
- Criteria for assigning grades.

Effective instruction at school/university is helpful to software industrial growth in several ways:

- **Quality perspective**: The software is first generated (in the form of a conceptual vision) in the developers mind. Software is application oriented and requires quality consciousness. Thus, quality of a software product is directly related to effective teaching of CSA in the school/university.
- **Productivity perspective**: Software organizational productivity is based on practical application and utilization of knowledge gained in the academic institution as a result of effective teaching. Thus, we strongly recommend emphasis on practical aspects of CSA to maximize software industrial growth.
- **Cycle time**: Focus on a particular software engineering process to minimize developmental life-cycle of each product and reduce overall cost.

Knowledge analysis should be two-fold:

- Impact on 'fundamental concepts'. This examines the educational base to ensure it is comprehensive, relevant, and efficient. This enables the software industry to generate compact products with low maintenance cost.
- Examine 'application to the real world problems'. This helps software industries to generate high quality projects with proper planning and estimation. It produces computer science and automation professionals to meet changing requirements of the job market.

We strongly believe that knowledge representation is of major importance for prospective software developers/leaders/managers. Academic institutions often stress knowledge chunks without improving the knowledge representation aspect. Lack of practical knowledge and experience makes it extremely difficult for students to apply what they have learned in a practical situation.

Higher education institutions can contribute to the software industrial growth by teaching:

- Ways to determine market demand: *Product* oriented
- Ways of defining the market field: *Process* oriented
- Educational programs for interdisciplinary students: *Specialization* oriented

Research

It is difficult to retain motivated students for CSA research in universities due to the immense attraction/demand of the software industry. In some countries it is a balance between the monthly paid scholarship and the relevant research domain. Lack of advanced research tools and motivated supervision causes CSA research to focus on extension of certain techniques rather than new innovations.

It is vital for CSA curricula to motivate students towards research programs and to continue research even after he/she leaves the academic institution. By continuation of research in the industry, this make him/her more productive:.

- Direct research to an application domain such as applet programming, quantum computing and certain computational aspects of Biotechnology.
- Develop applications of e-business to various applied domains.
- Generate new *software engineering* (SE) tools for code compression, design and testing.

The essence of CSA research and curricula in academic institutions should focus towards the following few seminal points [10]

- Integration of technology into the strategic objectives of the software firm.
  This focuses attention on growth and industrial maturity
- Ways to get into and out of technologies faster and more efficiently
- A methodology for evaluating technology more efficiently
- A strategic way for minimizing the product development time
- An intelligent way to manage large, complex and interdisciplinary projects

Software industrial growth depends on motivated, skilled and dedicated people who work in collaboration. Emphasis is on team skills. Those with higher educational qualifications often collaborate in technological research rather than software product development. Technological research progress should be directed towards software industrial needs in product development (e.g., coding standards), SE process development (e.g., CMM model), techniques for minimizing the SE life cycle (e.g., steps for improving speed of peer/technical reviews), improving quality of product, improving reuse potential, motivating developers, code compression techniques and other innovative technologies. To meet these needs we need to integrate research and education.

Society has grown ever more dependent on computing technology. Many sectors of science and industry anticipate ongoing shortages of well-trained computer scientists and engineers. The problem is compounded by a shortage qualified and motivated CSA teachers to integrate their research with the educational program. For example, there is a shortage of teachers of object-oriented programming languages. CSA programs should combine courses in reliability and security with object-oriented programming languages to produce conceptual models to simplify production of reliable and reusable software components.

CSA Teaching: A systematic Approach

In the literature there are many models of teaching and learning in the IT age [6] [11] [13] [14]. Researchers are scrutinizing systematic approaches for teaching CSA to respond to dynamic and rapid changes in software industrial growth. Here we present a systematic approach for teaching CSA from two different perspectives:

- CSA as part of leading edge technology
- Coping up with rapidly changing software industrial needs

Proposed Directions in CSA Education

Problem solving and theory are two corner stones of CSA; its disciplines possess a rich set of phenomena open to the researchers. An important strength of the CSA education is willingness to experiment with diverse models of education. For the current purpose, we classify educational systems into three broad categories: low-level, intermediate level, and senior level.

At the **low level** (school level), it is not reasonable to expect students to design good experiments. Instead, focus should be on exposing them to use experiments to study and analyze systems. Through experimentation, students can study and solve interesting problems even before they have developed programming skills. Experiments include ways to use operating systems such as MS DOS, UNIX and Windows. Educational institutions have different priorities in setting up educational levels for industry driven needs, general education and literacy. Due to these differences, it is not possible to come up with a common model that applies to all educational institutions. However, there should be designated curriculum standards to facilitate transition to the higher educational levels. Key elements include:

- Theoretical knowledge concepts with relevant physical examples
- Mathematical structures underlying the each physical concept.
- Experiments to provide a practical foundation for the competitive world of industry.

The **intermediate level** is college level education. It is intermediate between school and university educational systems and should focus on specialization and current and future trends. Having exposure to experimental methods at low level, students require fewer infrastructures and will be able to design and conduct small experiments on their own. This not only improves the intellectual caliber but also improves self-confidence. It is crucial for the candidate to apply theoretical knowledge to practical situations, and to verify and validate results through experiments. The outcome will resolve two questions:

- Did he/she learn the right things? and
- Did he/she learn things right?

Ultimately, this leads the student to determine his/her professional role such as scientist (researcher), academician, or a technician. Elements in that decision include:

- Emphasis on practical implementation of the learned knowledge.
- Penetrating vision towards research and theory.
- Specialization (data structures, programming languages, etc) or the aggregation world (general CS topics).
- Concentration in a specialized topic for advancement within that topic.

The **senior level** is a mature level - a university level. Every individual representative of a specialized topic and stands for its advancement. We call this post-graduate education. Having developed their experimental skills incrementally through open-ended experiments at the graduate level. Students at this level of the curriculum are better prepared to design experiments on their own. This helps the individual to build his or her career, and also cultivates understanding software industrial applications for their specialization.

A crescendo of criticism from industry warned that young software developers were not well equipped with needed skills for the world of work. Fledgling graduates were unpracticed in working as teams and incompetent at communicating with co-workers and managers, both orally and in writing.

The Art of Teaching and Needed Actions

The following needs were identified based on deficiencies in today's teaching of CSA:

- Focus on industry driven needs, which are often of short duration.
- Augment computer programming skills with other aspects of programming such as code compression techniques, reusable design techniques, and testing techniques.
- Involve leading edge technology in courses on design of intelligent systems; reduce emphasis on design/usage of simple automation tools.
- Implement faculty improvement programs to upgrade their caliber and learn new technologies based on suggestions of leading software industrialists.
- Narrow the gap between research directions in the academic institutions and software industrial needs.

Specific improvements to support fast software industrial growth include:

- Combine programming skill courses with certain heuristic aid for designing reusable code modules.
- Design automated tools for recognizing number of units for unit testing of a certain piece of code. Design of effective verification and validation tools.
- Develop computer aided tools, based on human psychology and cognitive psychology, to improve the developers' motivation.

Affect the following improvements in CSA teaching practices:

- Emphasise practical aspects based on experience, in the form of a documentation, such as small prototype projects, and certain advanced simulation techniques
- Refocus evaluation schemes (class assignments, tests, etc.) toward practical experiences.
- Integrate technological advancements from Internet and World Wide Web (WWW) for their practicality with the theoretical aspects.
- Improve teamwork and effectiveness by designing experiences to learn best practices in collaborative methods, communication, documentation, coding standards, and reporting. Incorporate individual and group teaching that simulates the culture and psychological environment of industry.

Software Development Organization: The Very Idea

By closely examining SDOs we realize they produce a "product" known as "software", using a well-defined "process". This process is mainly supported by some "tools" [9]. In the past, the work culture in SDO used to be effected by a single person. This is due to a belief that, boss knows the best. The engineering process and the quality of the final product are more influenced by the boss opinions/views, rather than sticking to any standards. Hence, the cost associated with maintainability used to be too high, when compared to the actual cost of the product.

The present generation has a work culture designed and developed using standard SEP software. For example, the software engineering institute capability maturity model (SEI CMM) [3] is a best possible model for such a process. Therefore, it is realized that the main credibility of a software product lies in the quality of the process through which it is generated. Therefore, we stress that there is a vital need to include the SE process in any CSA curricula.

The Nature of Work

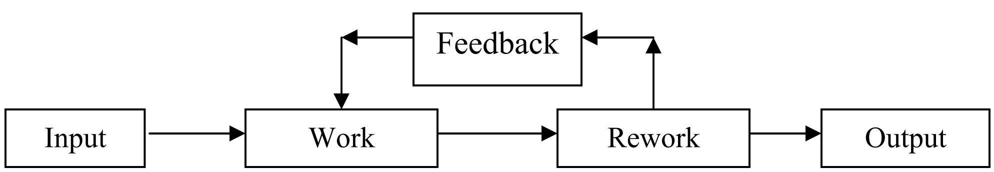
The nature of work in an SDO can be categorized based on two groups of people: The first group includes the people who do the work and the second group includes the people who organize it. The quality carrying properties of the first group includes:

- Collaborate and support good inter-group coordination,
- Recognize and close communication gaps,
- Distribute work equally,
- Attend weekly meetings, submit weekly work reports, and
- Participate in regular peer/technical reviews.

The quality carrying properties of the second group include:

- Keep track of customer communication/feedback,
- Buffer sudden impacts like injection/deletion/replacement of group members for various technical/non technical reasons, and finally,
- Manage people, programs, and materiel. For example, concurrently balancing personnel relationships, a sudden tool purchase, metrics collection, and software evaluation.

Management plays a vital role in the SDO and should be integral to IT and CS curricula. Mutual cooperation between these two categories of people play a major role in determining productivity of an organization. Any piece of 'work' in SDO will always have a 'rework' slot mainly for refinement/modification as follows:



Based on the literature, cost of maintenance is about 70% that of the cost of the product, and occurs primarily in the rework slots. Effective teaching methods and the concise IT and CS syllabi at the university level should help to minimize rework in industry.

The Impact of Teaching

Here we list some open questions faced by SDOs and the remedy with effective teaching of CSA:

How to Retain the Talented People?

One of the major issues in an SDO is to retain talented people. The internal training unit is an effective way for a developer to keep abreast of advanced technologies such as new language paradigms and design/coding/testing techniques. It is also effective for developing team skills and more effective work patterns.

How to Improve the Developers' Motivation?

It is impossible to give an exhaustive list of reasons to support this question. Based on our past experience, developers benefit from establishing a quality improvement facility (QIP). Apart from internal problems, software industries face the following problems as result of poor teaching at the respective academic institutions:

- Poor thinking, poor communication, lack of clear objectives.
- Unable to deliver code in optimum number of lines.
- Inefficient structures for reusable (code/design) modules.
- Lack of proper documentation capabilities.
- Poor inter-group coordination.

Some issues can be tackled with the effective teaching of CSA subjects at the university level. The following are remedial steps suggested by the respondents to the above queries.

Industry Academia Relation

The academia-industry relationship can assist in bridging the gap between the software industrial needs by directing personnel to the right jobs. The following improve/maintain relationships:

- **Recruitment and Campus Interviews**: Software industrial recruitment should occur in an academic institution. That is, the academic institute should provide such a seminal environment with in their campus for industrialists to select prospective employees.
- **Transfer of Ideas**: Each academician should play a prominent role in transferring the latest leading edge technology (derived from referred journals/periodicals/documents) to industry on a weekly/monthly basis.
- **Learning Organization**: Groups of academicians should form a training unit in each software industry to educate engineers/developers from time-to-time on pertinent topics of their on going projects.
- **Planned Transition**: Industry should allow final year students to visit software industries to realize the practicality of their theoretical and laboratory learned topics.

The Success Behind the SDOs

The most prominent aspect CSA teaching that contribute to success of SDOs can be visualized from two different angles viz., comfort level of the courses offered at the EI and the level of mathematics background in built in the curriculum [14]. The comfort level of the course is mainly useful in the implementation of the following vital properties useful for SDOs:

1. Implementing the interpersonal communication.
2. Implementing the sequenced instruction
3. Implementing objectives
4. Implementing the diagnostic evaluation

The mathematics background in built in CSA curriculum will have the positive effect on the SDO growth in the following ways:

1. Improving motivational techniques
2. Creating intellectual levels.

3. Enhancing software design skills, such as data flow diagrams, object oriented design and user interface design

As a whole the first four of these attributes contribute to the software engineering process improvement proposed by the SEI CMM. This is mainly helpful in the quality and reliability of the software products. The attributes like 5, 6 and 7 will further contribute to the organizational process maturity to cross the SEI CMM Level 5.

Conclusions

In this work we attempted to point out features vital for software industrial growth. Emphasis is concentrated on impact of computer science teaching on the software industrial growth.

We conclude that the growth of the software industry in any nation is proportional to the motivation and skills delivered by an academic institute, especially from the following viewpoints.

1. Give ongoing and continuous feedback on leading edge technology
2. Meet the job market with a future vision for establishing a competitive base

Refinement is needed to establish quality CSA programs in educational institutions. We believe there is an acute need for educational programs to change synergistically with SDO growth. It is important fto develop concomitant communication skills and inter-group coordination techniques vital for SDOs.

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STUDENT PAPER

Editor's Note: This study was conducted by a student at Connecticut State College. It is based on twenty eight questions to measure the similarities and differences of certain phenomenological aspects of distance learning experienced by students. It is reproduced here with the original tables and graphics produced in the SPSS analysis.

Student Self-Efficacy and the Distance Learning Experience

John DeCarlo

Abstract

This paper is about the way students, who are mostly adult, feel about the distance learning experience and how it might affect their self perception. I will attempt to examine whether it is convenience alone that drives this segment of higher education or there are other, more intrinsic factors that effect students' decisions to pursue knowledge by this alternative method.

If there is a nomothetic group of personality traits that cause a predisposition to this relatively new field of on-line learning they have not yet been identified

This paper is written to take a non-parametric statistical look, from an idiographic perspective, at some of the reasons a person might choose to pursue their education through distance learning. Some possible reasons which are examined are perceptions of self efficacy, the students' learning styles and their perceived satisfaction with elements of the distance learning experience. In its most basic form the question that I ask is: Are there certain personality types, which can be delineated statistically, that choose to pursue education through distance learning methods instead of by more traditional face-to-face encounters? If so, does the experience have an effect on their self perception and their perception of the system?

Phenomenological and Related Aspects of the Distance Learning Experience

Educational commitment to distance learning

The United States Department of Education (2002) reports that in 2000-2001 there were 2,810 regionally accredited institutions in the country that were offering purely distance degree programs to their students. Out of that number there were 1,570 (56%) undergraduate programs and 1,240 (44%) graduate programs. These numbers reflect actual degree offerings and do not take into consideration the literally thousands of credit courses being offered on-line by public and private, two and four year colleges and universities. Although Distance learning can take advantage of several forms of media the one that has experienced the most remarkable growth in the past several years has been the area of on-line, computer based delivery. In Connecticut alone, the Connecticut Distance Learning Consortium (2003) posted an increase of almost 400 distance courses offered by its 37 member colleges between 1998 and 2003 (see figure 1).

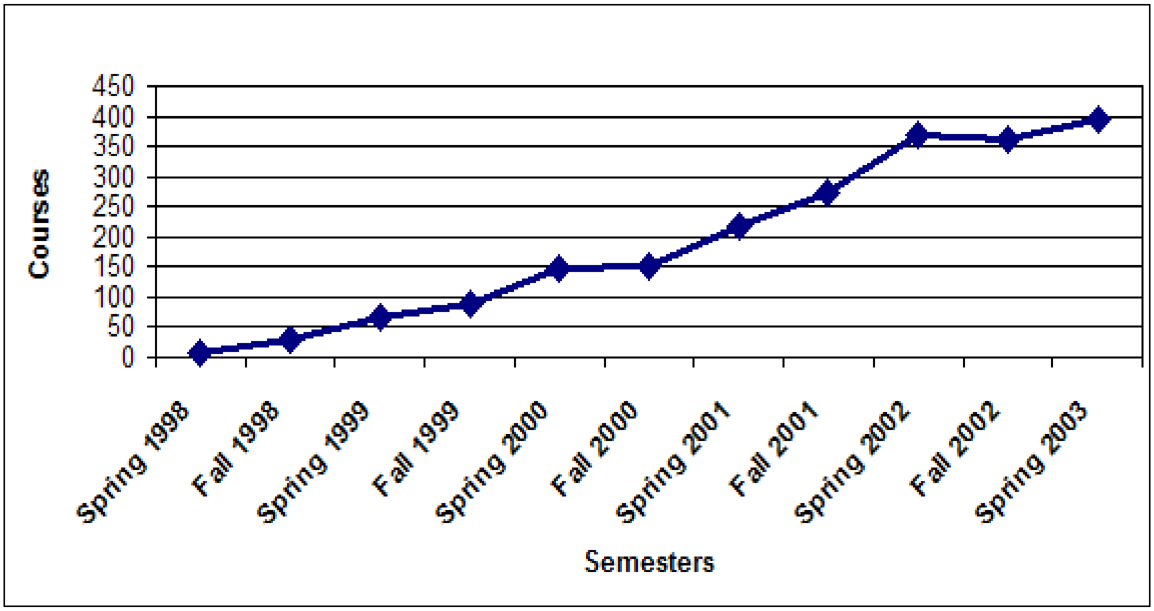

Figure 1 Courses: Connecticut Distance Learning Consortium
(courtesy of CTDLC)

During that same time period students in classes offered by the consortium increased by almost 7,000, giving a ratio of around seventeen students to each class where none existed five years ago (See figure 2). To say that distance, and especially, on-line class offerings have become popular would perhaps be an understatement. The ability of adult learners to return to school due to the broad dissemination that this technology offers has caused a rise in the adult learner population at institutions offering on-line classes. Adults have thrived in the distant learning environment. Without the accessibility of this form of knowledge delivery many current students would not have been able to return to school. The non-traditional, distance learning pedagogical model, which defines most on-line learning, serves a population of mid-career, adult learners. Until these types of classes started being offered many potential students were unable to return to the (virtual) classroom, because of work and family constraints, no matter the intensity of their desire to do so.

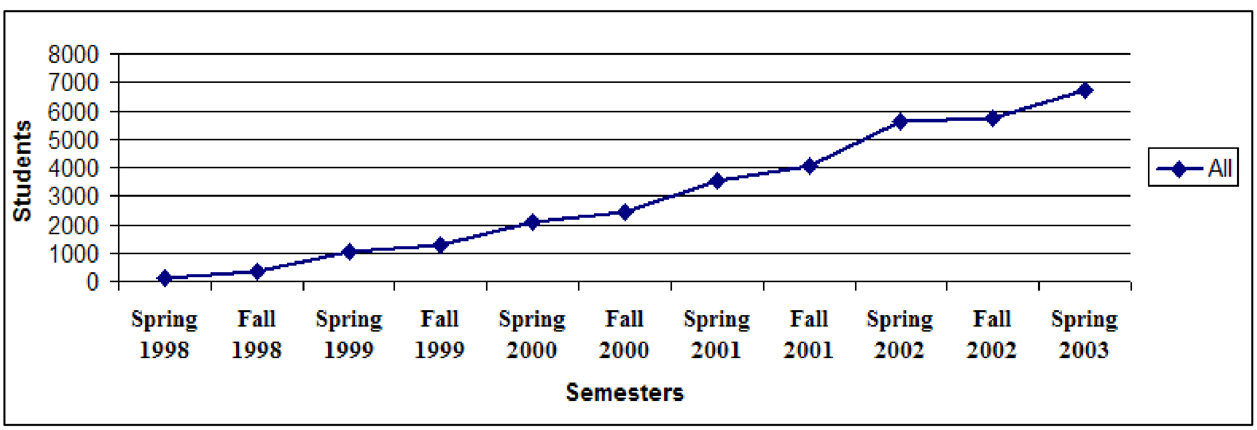

Figure 2 Number of Students
(courtesy of CTDLC)

Multiple personality factors

It is possible that returning to school because of the convenience that on-line courses offer is merely one of the factors that need to be present to ensure educational success for the student. The return to college for many adult learners represents a self actualizing tendency. The opportunities to not only increase their knowledge, skills and abilities but also to engage in the development of increased self efficacy and esteem seem to be important elements in their back to school decision. A returning student's ability to succeed is predicted in part by certain psychosocial and personality factors (Robbins et al., 2004). Achievement motivation, academic goals, institutional commitment, perceived social support, social involvement, academic self-efficacy, general self-concept, academic-related skills, and contextual influences are all contributing elements to success in the on-line learning environment.

Artistico, Cervone, & Pezzuti, (2003) have suggested that the way younger and older people perceive their self efficacy is different. They found that older people link their efficacy more with environmental inferences and how those interact with the personality of the individual. It was reinforced by Caprara, Caprara, and Steca (2003) that personality traits, self-efficacy, beliefs, values, and feelings of well-being are all affected to a certain degree by the age of the individual. This theory is consistent with the concept that andragogy brings with it its own special set of needs and reinforcements in educating adult learners. The way they learn both on-line and on-ground is different than the way younger persons do (Barrouillet, Bernardin, & Camos, 2004). It appears that institutions concentrating on adult learners must take these psychosocial and personality factors of their target population into consideration to both attract the students and then enhance their ability to achieve academic success.

Method

This study is based on a survey consisting of twenty eight questions that were compiled to measure the similarities and differences of certain phenomenological aspects of the distance learning experience by students. (See Appendix A for the survey.) Charter Oak State College does not currently have an internal review board for research conducted by its faculty or students. Because of this I submitted my research proposal to the Academic Council for their approval in lieu of an I.R.B. After the Academic Council reviewed the proposal authorization was received to disseminate the survey instrument.

Participants

Invitations were made to 54 Charter Oak State College students and 180 distance learning students at other on-line institutions. The survey was hosted at a web site and potential participants were asked to visit the URL provided in the invitation if they wished to take part in the survey. 112 students or 44% visited the survey website and actually participated. The sample group consisted of 20 Charter Oak students (17.8%) and 92 students from other institutions (82.2%). Of those answering the survey 33% were female and 67% were male, 66% of the participants were married and 33% were not. 50.9% of the sample did not live with children in their households, 19.1% had one child, 19.1% had two children, 8.2% had three children and 2.7% had four or more children living with them. 13.6% of the study group was unemployed or worked less than twenty hours per week, 11.8% put in 21 to 39 hours on their job per week and 74.5% spent forty or more hours working per week. The range of ages (table 1 & Figure 3) represented were 17 to 24 years old 6.3%, 25 to 30 years old 16.2%, 31 to 36 years old 23.4%, 37 to 42 years old 17.1%, 43 to 48 years old 18.9%, 49 to 54 years old 9%, 55 to 60 years old 6.3% and over 60 years old 2.7%.

Table 1

AGE RANGE

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	17 to 24	7	6.3	6.3	6.3
	25 to 30	18	16.1	16.2	22.5
	31 to 36	26	23.2	23.4	45.9
	37 to 42	19	17.0	17.1	63.1
	43 to 48	21	18.8	18.9	82.0
	49 to 54	10	8.9	9.0	91.0
	55 to 60	7	6.3	6.3	97.3
	over 60	3	2.7	2.7	100.0
	Total	111	99.1	100.0	
Missing	0	1	.9		
Total		112	100.0		

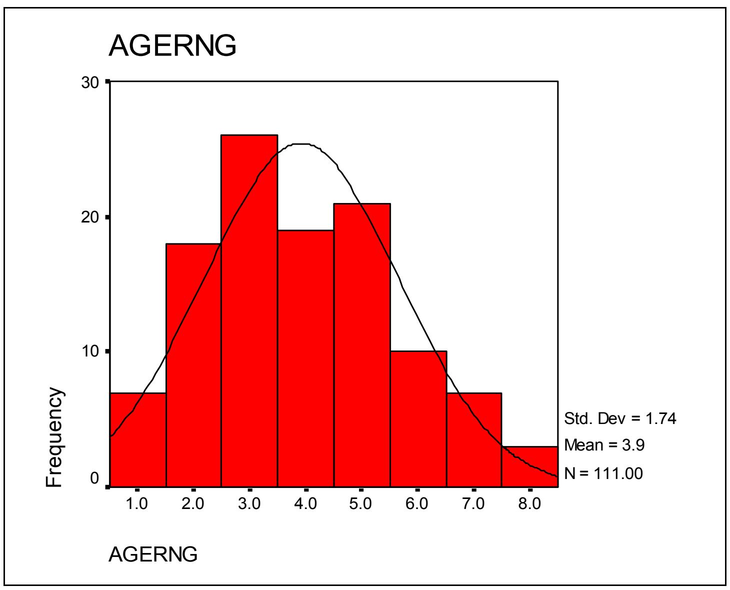

Figure 3

97% of the individuals had taken at least one distance learning class and out of that group 50% had taken ten or more Distance Learning classes. When it came to having taken challenge exams like CLEP or DANTES exams 41.8% of the students reported having tried at least one. 48.6% of the group of distance learning students that participated in this study said that on average they study between five and ten hours per week per on-line course followed by 23.4% of the students who study between eleven and sixteen hours per course every week. (Table 2 & figure 4)

Table 2

STDYTIME

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	<5	11	9.8	9.9	9.9
	5 to 10	54	48.2	48.6	58.6
	11 to 16	26	23.2	23.4	82.0
	17 to 20	9	8.0	8.1	90.1
	>20	11	9.8	9.9	100.0
	Total	111	99.1	100.0	
Missing	0	1	.9		
Total		112	100.0		

40.9% of the study group does the majority of their studying during the week days and 59.5% report that they take distance learning courses exclusively. Fully 60.6% of the sample said that if all else were equal they would prefer to study by distance with 24.8% stating a preference for on-ground courses and 14.7% not having a preference. It would be interesting to reexamine this figure again with a wider sample group that included traditional students as well.

Table 3

WESTDY

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	16	14.3	14.5	14.5
	Agree	17	15.2	15.5	30.0
	Somewhat	45	40.2	40.9	70.9
	Disagree	32	28.6	29.1	100.0
	Total	110	98.2	100.0	
Missing	0	2	1.8		
Total		112	100.0		

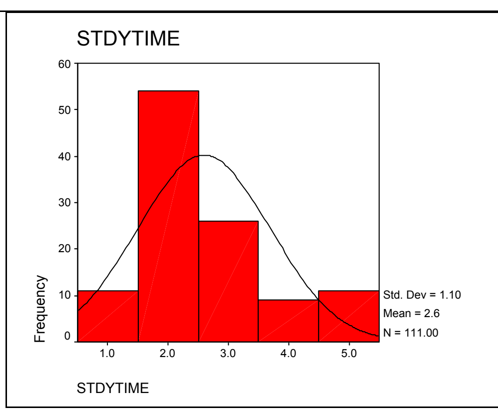

Figure 4

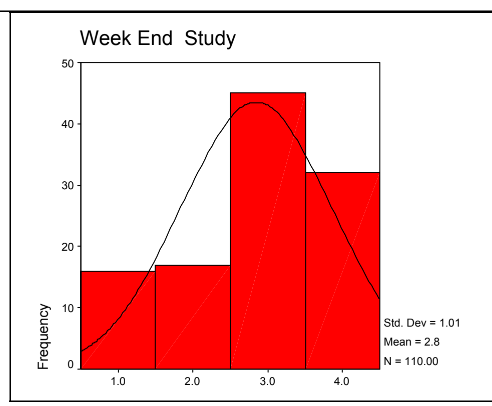

Figure 5

Results

The distance learners that participated in this study answered positively to every aspect of phenomenological measures of increased self efficacy. When asked if they could figure out a problem on their own in a course, 87.2% of them strongly agreed or agreed that they could. When responding to a question on whether distance learning helped them to think critically 93.6% answered positively with 37.3% strongly agreeing, 37.3% agreeing and 19.1% agreeing somewhat. 100% of the respondents answered affirmatively to the question on whether they could handle obstacles in their studies effectively. Another 95% of the sample reported that distance learning increased their overall confidence level. The people who thought that distance learning made them a better computer user was at a smaller percentage (about 50%). This was possibly due in part to the fact that this population was already facile with computer technology and specifically on-line classes, before experimenting with distance learning.

One hundred percent of the students surveyed believed that they could succeed in any course they registered for. About another 67% believed that DL courses helped them on their job and another 94% believed that they used their study time effectively while taking distance learning courses.

In addition, the distance learning students in this study had a strong tendency to report positively on measurements associated with a visual learning style. Based on surveys designed to show positive correlation between traits of visualization, direction and orientation (Kolb, 1984) (Smith & Kolb, 1986) respondents answered consistently over 90% positively in each of the three measurements. (See figures 14, 15 and 16 in appendix B)

Chi Square correlations

To supplement the findings above chi square tests for independence were calculated to find if there were any differences in the confidence levels of males and females. A Pearson Chi-Square of 4.316 with a $p = .29$ was calculated. Since, to be statistically significant, the alpha would have to have been .05 or less, it was found that males and females did not feel substantially different in the area of confidence.

Table 4

GENDER * Confidence Level Crosstabulation

			Confidence Level				Total
			Very Much	Moderately	Somewhat	No	
GENDER	Female	Count	7	18	6	3	34
		Expected Count	10.8	16.4	5.3	1.5	34.0
		% within GENDER	20.6%	52.9%	17.6%	8.8%	100.0%
		% within Confidence Level	20.0%	34.0%	35.3%	60.0%	30.9%
		% of Total	6.4%	16.4%	5.5%	2.7%	30.9%
	Male	Count	28	35	11	2	76
		Expected Count	24.2	36.6	11.7	3.5	76.0
		% within GENDER	36.8%	46.1%	14.5%	2.6%	100.0%
		% within Confidence Level	80.0%	66.0%	64.7%	40.0%	69.1%
		% of Total	25.5%	31.8%	10.0%	1.8%	69.1%
Total		Count	35	53	17	5	110
		Expected Count	35.0	53.0	17.0	5.0	110.0
		% within GENDER	31.8%	48.2%	15.5%	4.5%	100.0%
		% within Confidence Level	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	31.8%	48.2%	15.5%	4.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.316[a]	3	.229
Likelihood Ratio	4.286	3	.232
Linear-by-Linear Association	3.628	1	.057
N of Valid Cases	110		

a.

Interestingly, the number of children in a student's household and the amount of study time that that student spent on each of their classes did not seem to be linked. The dependent variable of hours studied held steady across when the independent variable of number of children changed. The last chi square test that was conducted was to examine if hours of study were affected by hours worked in a week. No correlation was found. Students who worked full time were able to find time for their studies in the same percentages as were students who worked less. (See tables 15 and 16 in appendix B)

Discussion

In summary, distance learning students are an independent group who are high in confidence, have positive feelings of self efficacy, and possess visual learning styles. In general, they would rather pursue their education via distance learning even when more traditional alternatives are available.

Educational institutions have recognized the distance learning student population and are making strides in accommodating this more independent, adult group. It is uncontestable that learning at a distance is a more convenient route to higher education than more traditional, brick and mortar schools for some adults. It is also possible that the independence demonstrated by this group is also due to other, more intrinsic factors. The ability to study with professors who would not normally be available to them and to find classes and programs not in their reach traditionally are also factors that cause people to pursue distance education. The phenomenology that is manifest in these students and their individual pursuit for self efficacy suggests that there are multiple personality factors that affect the decision to pursue distance education as an alternative.

The last section of the survey asked how important to them and how satisfied they were with:

1.) The way distance learning allows them to pace studies to accommodate their lives.
2.) Instructors provide timely feedback.
3.) Adequacy of instructor interaction.
4.) Procedures for enrolling in distance courses.

In every case, the subject of the question was highly important to students. Also, in each case, students were generally satisfied with the outcomes. Instructor interaction and timeliness of feedback were reported as satisfactory but less so than satisfaction with overall flexibility and institutional procedures such as enrollment. It might be relevant in future research to compare these perceptions to those of on-ground students and to also conduct longitudinal studies to see if these areas change with further maturation and sophistication of the course environments. Adaptive pedagogies to accommodate this new technology along with the increasing population of distance students will offer many interesting opportunities for study. Both the subjective, phenomenological characteristics of this paradigm and the more objectively, intrinsic factors that seem to be driving the growth of this educational venue are as full of questions for researchers as they are answers for their students.

Summary

In summary, distance learning students are an independent group who are high in confidence, have positive feelings of self efficacy, and possess visual learning styles. In general, they would rather pursue their education via distance learning even when more traditional alternatives are available.

On-line Distance learning is adding a new dimension to higher education not only because it makes use of heretofore unavailable technology but because it makes education accessible. It has been suggested by Muchinsky (2003) that the computer is one of the "dominant technological innovations" regarding education in the last 50 years. The potential that computer based training brings to efficiently distribute higher education makes the supposition that that life-long learning will become much more common seem inevitable.

Note: Graphics in this paper were imported from SPSS.

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APPENDIX A

Distance Learning Survey

1. What is your gender?
 ☐ Female ☐ Male

2. What is your marital status?
 ☐ Married ☐ Not Married

3. Number of children under 18 who live with you at least part time.
 ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 or over

4. How many hours per week do you spend doing your job?
 ☐ 20 or under ☐ 21 to 39 ☐ 40 or over

5. What is your age?
 ☐ 17-24 ☐ 31-36 ☐ 43-48 ☐ 55-60
 ☐ 25-30 ☐ 37-42 ☐ 49-54 ☐ Over 60

6. How many distance leaning courses have you taken?
None
 ☐ 1 ☐ 3 ☐ 5 ☐ 7 ☐ 9
 ☐ 2 ☐ 4 ☐ 6 ☐ 8 ☐ 10 ☐ Over 10

7. Have you taken challenge exams (like DANTES or CLEP?)
 ☐ Yes ☐ No

8. How many hours per week do you study/work on each of your distance learning classes?
 ☐ Under 5 ☐ 5-10 ☐ 11-16 ☐ 17-20 ☐ Over 20

9. If you are now an under graduate student would you prefer continuing on to a distance learning or a traditional grad school?
 ☐ Distance learning
 ☐ Traditional
 ☐ Don't think I will go to grad school in the near future
 ☐ Already in grad school

10. I study mostly on weekends
 ☐Strongly agree
 ☐ Agree
 ☐ Somewhat agree
 ☐ Disagree

11. Do you also take on-ground courses at a college or university while you take DL courses?
 ☐ Yes ☐ Sometimes ☐ Never

12. If all else were equal would you prefer distance learning or traditional courses?

☐ Distance ☐ Traditional ☐ No Preference

13. How satisfied are you with DL course selection over all?

☐ Very satisfied
☐ Satisfied
☐ Somewhat satisfied
☐ Not satisfied

14. Does taking DL college classes help you on your job now?

☐ Yes, very much
☐ Yes, sometimes
☐ Yes, infrequently
☐ No, does not help

15. Does DL learning increase your overall confidence level?

☐ Yes, very much
☐ Yes, sometimes
☐ Yes, infrequently
☐ No, does not help

16. I have a good sense of direction

☐ Yes, very good
☐ I have an ok sense of direction
☐ I get lost easily

17. DL classes have helped me learn to think critically

☐ Agree strongly
☐ Agree
☐ Agree somewhat
☐ Do not agree

18. DL classes have made me a better computer user

☐ Agree strongly
☐ Agree
☐ Agree somewhat
☐ Do not agree

19. If I get confused in a course I can usually figure it out myself

☐ Agree strongly
☐ Agree
☐ Agree somewhat
☐ Do not agree

20. I can succeed at almost any course I register in.

☐ Agree strongly
☐ Agree
☐ Agree somewhat
☐ Do not agree

21. I make good use of my time when I work on DL courses

- ☐ Agree strongly
- ☐ Agree
- ☐ Agree somewhat
- ☐ Do not agree

22. I am able to overcome obstacles that I encounter in my studies

- ☐ Agree strongly
- ☐ Agree
- ☐ Agree somewhat
- ☐ Do not agree

23. I am good at visualizing stories as I read them

- ☐ Agree strongly
- ☐ Agree
- ☐ Agree somewhat
- ☐ Do not agree

24. I easily form a mental map of my neighborhood.

- ☐ Agree strongly
- ☐ Agree
- ☐ Agree somewhat
- ☐ Do not agree

25. My DL program allows me to pace my studies to fit my life and work schedules
Important to me

☐ Not at all ☐ Not very ☐ Somewhat ☐ Very ☐ Extremely

My level of satisfaction

☐ Not at all ☐ Not very ☐ Somewhat ☐ Very ☐ Extremely

26. My DL instructors provide timely feed back about my academic progress.
Important to me

☐ Not at all ☐ Not very ☐ Somewhat ☐ Very ☐ Extremely

My level of satisfaction

☐ Not at all ☐ Not very ☐ Somewhat ☐ Very ☐ Extremely

27. The frequency of interaction with my DL instructors is adequate
Important to me

☐ Not at all ☐ Not very ☐ Somewhat ☐ Very ☐ Extremely

My level of satisfaction

☐ Not at all ☐ Not very ☐ Somewhat ☐ Very ☐ Extremely

28. Process and procedures for enrolling in DL courses are convenient
Important to me

☐ Not at all ☐ Not very ☐ Somewhat ☐ Very ☐ Extremely

My level of satisfaction

☐ Not at all ☐ Not very ☐ Somewhat ☐ Very ☐ Extremely

APPENDIX B

Charts and Tables

Table 5

If I become confused in a couse I can usually figure it out myself

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree Strongly	36	32.1	32.7	32.7
	Agree	60	53.6	54.5	87.3
	Somewhat	13	11.6	11.8	99.1
	Don't Agree	1	.9	.9	100.0
	Total	110	98.2	100.0	
Missing	0	2	1.8		
Total		112	100.0		

Table 6

Distance learning courses have helped me to think critically

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree Strongly	41	36.6	37.3	37.3
	Agree	41	36.6	37.3	74.5
	Somewhat	21	18.8	19.1	93.6
	Don't Agree	7	6.3	6.4	100.0
	Total	110	98.2	100.0	
Missing	0	2	1.8		
Total		112	100.0		

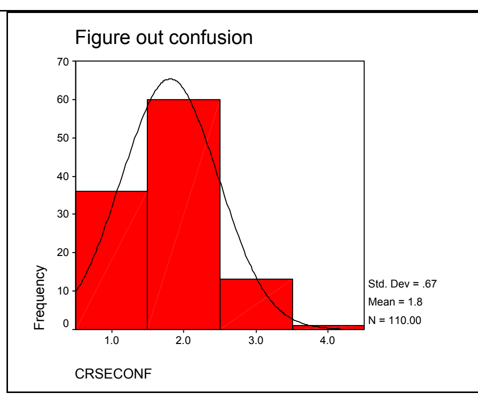

Figure 6

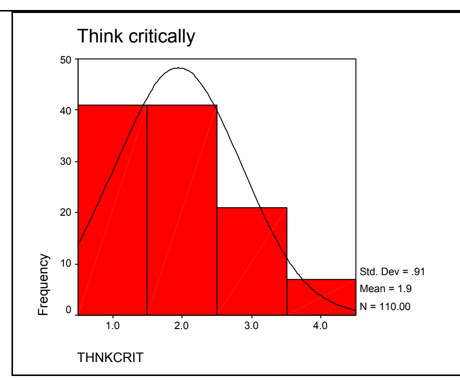

Figure 7

Table 7

I am able to overcome obstacles that I encounter in my studies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree Strongly	42	37.5	38.2	38.2
	Agree	61	54.5	55.5	93.6
	Somewhat	7	6.3	6.4	100.0
	Total	110	98.2	100.0	
Missing	0	2	1.8		
Total		112	100.0		

Table 8

Does distance learning increase your overall confidence level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Much	35	31.3	31.5	31.5
	Moderately	54	48.2	48.6	80.2
	Somewhat	17	15.2	15.3	95.5
	No	5	4.5	4.5	100.0
	Total	111	99.1	100.0	
Missing	0	1	.9		
Total		112	100.0		

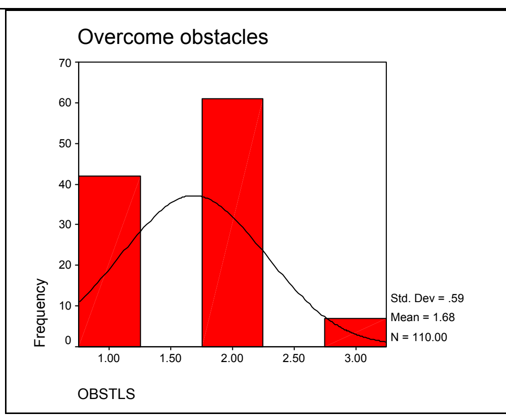

Figure 8

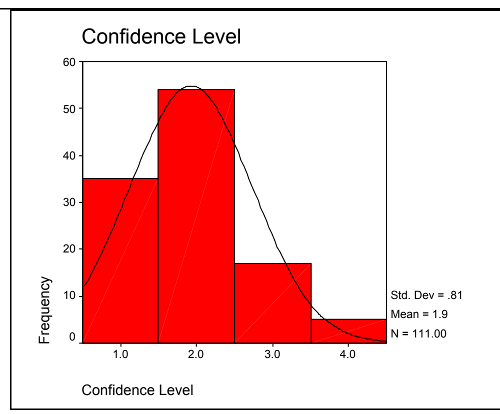

Figure 9

Table 9

Taking DL courses has made me a better computer user

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree Strongly	25	22.3	22.9	22.9
	Agree	29	25.9	26.6	49.5
	Somewhat	20	17.9	18.3	67.9
	Don't Agree	35	31.3	32.1	100.0
	Total	109	97.3	100.0	
Missing	0	3	2.7		
Total		112	100.0		

Table 10

Does taking DL courses help you on your job?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very Much	32	28.6	28.8	28.8
	Sometimes	43	38.4	38.7	67.6
	Infrequently	13	11.6	11.7	79.3
	No	21	18.8	18.9	98.2
	5	2	1.8	1.8	100.0
	Total	111	99.1	100.0	
Missing	0	1	.9		
Total		112	100.0		

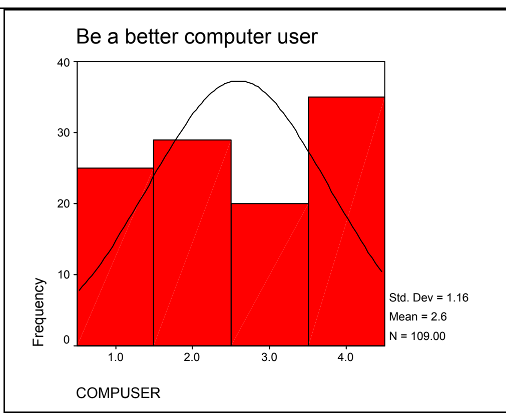

Figure 10

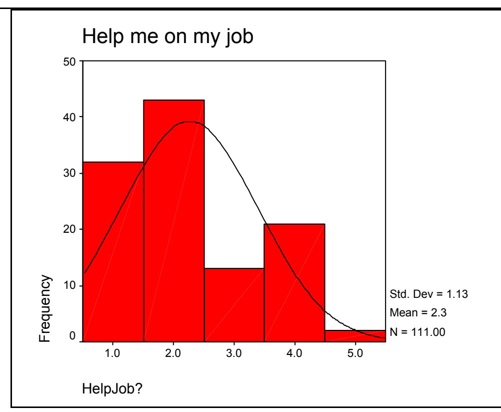

Figure 11

Table 11

I make good use of my time when I work on DL courses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree Strongly	37	33.0	33.3	33.3
	Agree	56	50.0	50.5	83.8
	Somewhat	12	10.7	10.8	94.6
	Don't Agree	6	5.4	5.4	100.0
	Total	111	99.1	100.0	
Missing	0	1	.9		
Total		112	100.0		

Table 12

I can succeed at almost any course I register for

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree Strongly	50	44.6	45.0	45.0
	Agree	48	42.9	43.2	88.3
	Somewhat	13	11.6	11.7	100.0
	Total	111	99.1	100.0	
Missing	0	1	.9		
Total		112	100.0		

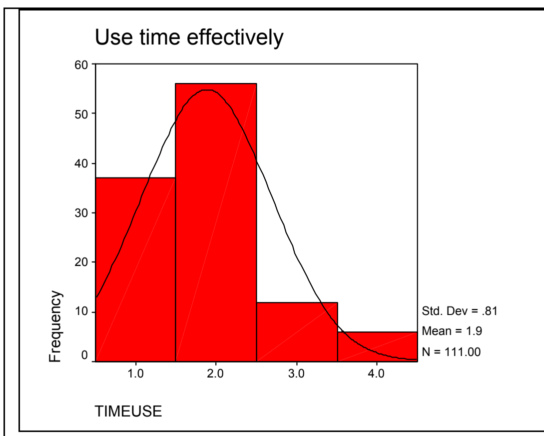

Figure 12

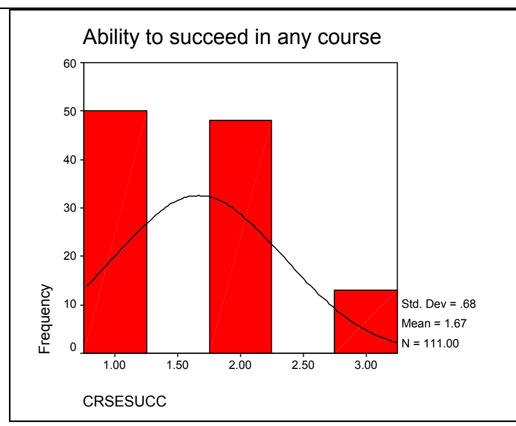

Figure 13

Table 13

VISUAL

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree Strongly	43	38.4	39.1	39.1
	Agree	54	48.2	49.1	88.2
	Somewhat	10	8.9	9.1	97.3
	Don't Agree	3	2.7	2.7	100.0
	Total	110	98.2	100.0	
Missing	0	2	1.8		
Total		112	100.0		

Table 14

MAP

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree Strongly	45	40.2	40.9	40.9
	Agree	42	37.5	38.2	79.1
	Somewhat	19	17.0	17.3	96.4
	Don't Agree	4	3.6	3.6	100.0
	Total	110	98.2	100.0	
Missing	0	2	1.8		
Total		112	100.0		

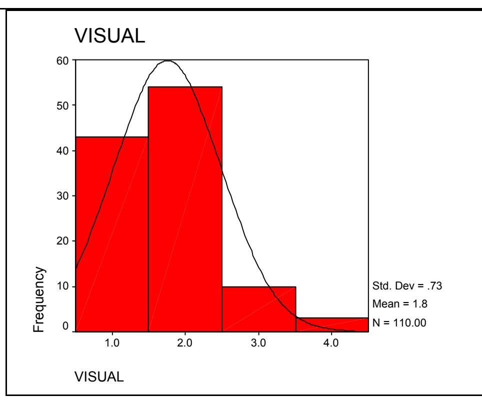

Figure 14

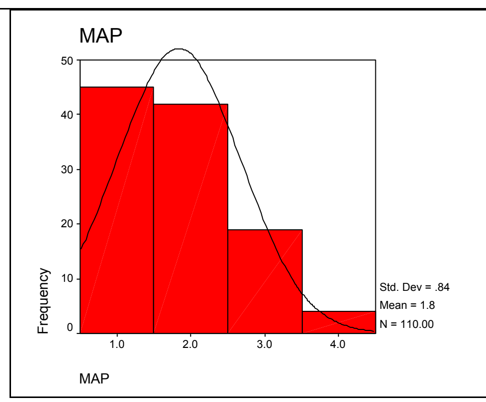

Figure 15

Table 15

DIRECTN

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very good	77	68.8	69.4	69.4
	Fair	26	23.2	23.4	92.8
	Poor	8	7.1	7.2	100.0
	Total	111	99.1	100.0	
Missing	0	1	.9		
Total		112	100.0		

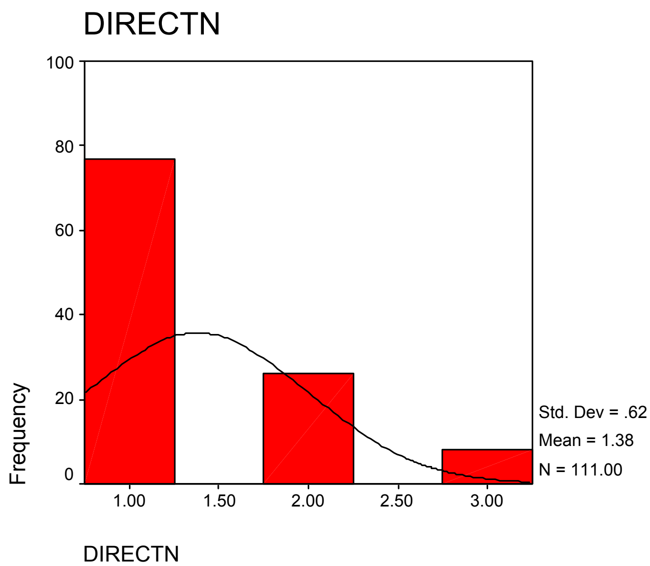

Figure 16

Table 16

KIDS * STDYTIME Crosstabulation

			STDYTIME					
			<5	5 to 10	11 to 16	17 to 20	>20	Total
KIDS	0	Count	3	27	13	6	7	56
		Expected Count	5.6	27.0	13.2	4.6	5.6	56.0
		% within KIDS	5.4%	48.2%	23.2%	10.7%	12.5%	100.0%
		% within STDYTIME	27.3%	50.9%	50.0%	66.7%	63.6%	50.9%
		% of Total	2.7%	24.5%	11.8%	5.5%	6.4%	50.9%
	1	Count	5	9	4	2	1	21
		Expected Count	2.1	10.1	5.0	1.7	2.1	21.0
		% within KIDS	23.8%	42.9%	19.0%	9.5%	4.8%	100.0%
		% within STDYTIME	45.5%	17.0%	15.4%	22.2%	9.1%	19.1%
		% of Total	4.5%	8.2%	3.6%	1.8%	.9%	19.1%
	2	Count	2	10	6	1	2	21
		Expected Count	2.1	10.1	5.0	1.7	2.1	21.0
		% within KIDS	9.5%	47.6%	28.6%	4.8%	9.5%	100.0%
		% within STDYTIME	18.2%	18.9%	23.1%	11.1%	18.2%	19.1%
		% of Total	1.8%	9.1%	5.5%	.9%	1.8%	19.1%
	3	Count	0	6	2	0	1	9
		Expected Count	.9	4.3	2.1	.7	.9	9.0
		% within KIDS	.0%	66.7%	22.2%	.0%	11.1%	100.0%
		% within STDYTIME	.0%	11.3%	7.7%	.0%	9.1%	8.2%
		% of Total	.0%	5.5%	1.8%	.0%	.9%	8.2%
	4 or over	Count	1	1	1	0	0	3
		Expected Count	.3	1.4	.7	.2	.3	3.0
		% within KIDS	33.3%	33.3%	33.3%	.0%	.0%	100.0%
		% within STDYTIME	9.1%	1.9%	3.8%	.0%	.0%	2.7%
		% of Total	.9%	.9%	.9%	.0%	.0%	2.7%
Total		Count	11	53	26	9	11	110
		Expected Count	11.0	53.0	26.0	9.0	11.0	110.0
		% within KIDS	10.0%	48.2%	23.6%	8.2%	10.0%	100.0%
		% within STDYTIME	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	10.0%	48.2%	23.6%	8.2%	10.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.194[a]	16	.730
Likelihood Ratio	12.934	16	.678
Linear-by-Linear Association	1.550	1	.213
N of Valid Cases	110		

a. 19 cells (76.0%) have expected count less than 5. The minimum expected count is .25.

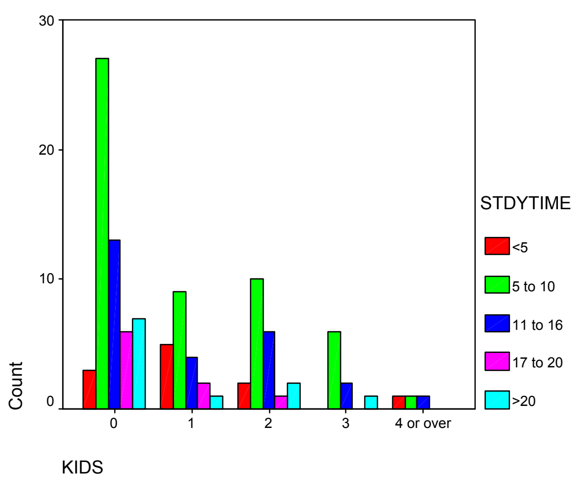

Figure 17

Table 17

HOURSWRK * STDYTIME Crosstabulation

			STDYTIME					Total
			<5	5 to 10	11 to 16	17 to 20	>20	
HOURSWRK	20 or under	Count	2	8	1	2	2	15
		Expected Count	1.5	7.3	3.6	1.2	1.4	15.0
		% within HOURSWRK	13.3%	53.3%	6.7%	13.3%	13.3%	100.0%
		% within STDYTIME	18.2%	15.1%	3.8%	22.2%	20.0%	13.8%
		% of Total	1.8%	7.3%	.9%	1.8%	1.8%	13.8%
	21 to 39	Count	1	7	3	1	1	13
		Expected Count	1.3	6.3	3.1	1.1	1.2	13.0
		% within HOURSWRK	7.7%	53.8%	23.1%	7.7%	7.7%	100.0%
		% within STDYTIME	9.1%	13.2%	11.5%	11.1%	10.0%	11.9%
		% of Total	.9%	6.4%	2.8%	.9%	.9%	11.9%
	40 or over	Count	8	38	22	6	7	81
		Expected Count	8.2	39.4	19.3	6.7	7.4	81.0
		% within HOURSWRK	9.9%	46.9%	27.2%	7.4%	8.6%	100.0%
		% within STDYTIME	72.7%	71.7%	84.6%	66.7%	70.0%	74.3%
		% of Total	7.3%	34.9%	20.2%	5.5%	6.4%	74.3%
Total		Count	11	53	26	9	10	109
		Expected Count	11.0	53.0	26.0	9.0	10.0	109.0
		% within HOURSWRK	10.1%	48.6%	23.9%	8.3%	9.2%	100.0%
		% within STDYTIME	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	10.1%	48.6%	23.9%	8.3%	9.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.539[a]	8	.896
Likelihood Ratio	4.156	8	.843
Linear-by-Linear Association	.000	1	.986
N of Valid Cases	109		

a. 8 cells (53.3%) have expected count less than 5. The minimum expected count is 1.07.

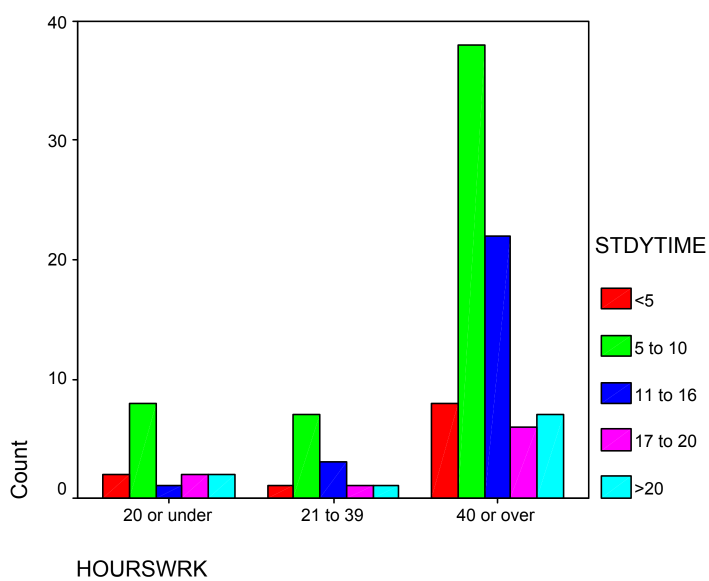

Figure 18

About the Author

John DeCarlo recently graduated from Charter Oak College in Connecticut with an interdisciplinary B.S. He enjoyed his distance learning experience so thoroughly that he is entering an MA program in Organizational Studies at Saybrook Graduate School in the fall. His paper about phenomenological aspects of distance learning includes graphics imported from SPSS.

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