ABSTRACT

This manuscript explores some ideas for developing enduring higher-order cognitive thinking skills in our classrooms. Narrating personal experiences from teaching and learning in and outside classrooms for 25 years, and observing numerous overlaps among existing models in PER, CD, & CM, the manuscript solicits feedback from readers to address some challenges mentioned here.

Current trends in physics education research (PER), career development (CD), and classroom management (CM), and how they might promote smart education are outlined in this draft. Developing epistemic games to foster a constructivist learning environment appears to be a distinct possibility for blending subject expertise with CD and CM. The expertise of instructional designers in the development of such games (computer based and online), which could be tested by practitioners subsequently in the different disciplines (physicists, linguists, historians, and so on), will go a long way in establishing their meaningful instructional use.

GOALS, PHILOSOPHY, and REFLECTION: WORKING MANUSCRIPT

SMART EDUCATION: BLENDING SUBJECT EXPERTISE
WITH THE CONCEPT OF CAREER DEVELOPMENT
FOR EFFECTIVE CLASSROOM MANAGEMENT.

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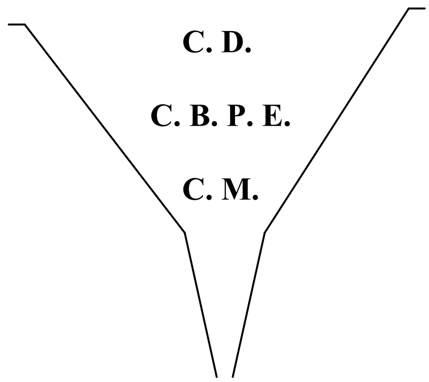
INTRODUCTION

I shall outline briefly my story, describing my teaching and learning experiences, in high schools for almost 25 years. The stimulus for this historical approach, vital to understanding the rest of the manuscript, came from Malcolm's educational research (Wells, Hestenes, & Swackhamer, 1995). As a student in high school, I was inspired by a professor tutoring chemistry, and consequently wrote a chemistry lab manual (unpublished) for high school students. In my freshman year, a chemical engineer stimulated my interest in industrial and engineering chemistry. Beyond these two instructors, and more recently my doctoral advisor, most of my school and university faculty (no offence and with due apologies), were largely uninspiring and relied more on reading or copying off "notes" for their lecture-based instruction.

A metacognitive approach that I narrate below describing how I learned physics and table tennis, is responsible for my passion to understand self-directed learning and self-organizing systems. Metacognition (Reigeluth & Moore, 1999) is the ability to think about one's own thinking. It is a process of learning about one's own learning, which encompasses "reflective thinking" (Dewey, 1933), "critical thinking" (APA Delphi Report, 1990) and "breakthrough thinking" (Perkins, 2000). A definition of these three terms and their implications for learning will be discussed later on in a section titled "principles of self organization." According to Reigeluth (1999), the different types of learning might be conceived as an overlapping continuum between four categories: memorizing information, understanding relationships, applying skills, and applying generic skills. In this manuscript, I illustrate some of these concepts, pertaining to knowledge, behavior, and abilities, in an attempt to articulate my three core ideas: concept-based physics education (CBPE), career development (CD) and classroom management (CM). My current thinking, influenced by the deductive (or funnel) approach, positions CD, CBPE, and CM, as illustrated:



Career development relates to self-development of students and could help them relate learning to real-life experiences. Physics might be replaced by any other subject (where students typically learn skills, techniques and strategies useful for life), and teacher-student learning takes place typically in classroom settings.

Interestingly, it was my 14-year classroom experience teaching physics that led me to consider the importance of career development in the first instance. The process was evidently more inductive in its development. I elaborate on the interrelatedness between the three ideas in the sections that follow. Each idea has three broad headings: narrative, challenges and needs, and issues. Narratives provide a historical introduction to the ideas. Challenges and needs details insights from literature on these ideas. Issues will deliberate on my thoughts on these ideas. Although my thinking passed through several iterations within the first semester of the doctoral program, these ideas reflect my personal philosophy and long-term professional goals.

THEORETICAL FRAMEWORK

Having just commenced my doctoral program, I look forward to studying theoretical frameworks that might help address some challenges outlined in the various sections above. Nevertheless, two theories that had its origins in the 1940s caught my attention. They are field theory and game theory. I considered human motivation and relationships as important aspects of student learning and developed an appreciation for the humanistic vision of Carl Rogers. Studying Rogers' work over five decades led me to Kurt Lewin's field theory. I will list some characteristics that made me gravitate towards these theories and it is beyond the scope of this manuscript to tie them individually to the challenges described before.

When I expressed an interest in studying field theory, a professor remarked that he "never understood field theory." In my teaching experience, I saw a parallel, because adults often articulate their value judgments in front of their children, "I never understood math or physics", but not commonly "I never understood history or whatever". These negative perceptions reinforce a poor work ethic in children early on and often made my task as physics teacher difficult. Fortunately, the *American Psychological Association*'s reprint of Lewin in 1997 "to stimulate renewed interest among contemporary scholars in Lewin's work" helped me easily access his writings.

Field Theory

Kurt Lewin (1942) describes six characteristics of field theory, and the latter four characteristics particularly makes this theory unique. They are:

Constructive rather than classificatory method

Unlike a classificatory method that grouped systems based on similarities, a constructive method groups systems "according to the way they can be produced or derived from each other (Lewin, 1942, p. 212)." Consequently, "an infinite number of constellations" might be constructed in accordance with general laws of psychology so that "each of those constellations corresponds to an individual case at a given time (ibid, p. 213)."

Dynamic approach

Dynamic here refers to "an interpretation of changes as the result of psychological force." This theory attempts to use "scientific constructs and methods " to deal with "underlying forces of behavior. . . in a methodologically sound manner (ibid, p. 213)."

Psychological approach

Field theory is "behavioristic" in the sense, it has a tendency to provide "operational definitions (testable symptoms) for the concepts used." Lewin argues that "a teacher will never succeed in giving proper guidance to a child if he does not learn to understand the psychological world in which the individual child lives (ibid, p. 213)"

Analysis beginning with the situation as a whole

Field theory seeks to analyze situations this way because it recognizes that the importance of isolated elements within a situation "cannot be judged without consideration of the situation as a whole." Lewin observes, "every child is sensitive, even to small changes in social atmosphere, such as the degree of friendliness or security. The teacher knows that success in teaching French, or any other subject, depends largely on the atmosphere he is able to create (ibid, p. 214)."

Behavior as a function of the field at the time it occurs

According to Lewin, all behavior (including action, thinking, wishing, striving, valuing, achieving, etc) can be conceived of as a change of some state of a field in a given unit of time within the "life space" of individuals (ibid. pp. 161-162). Recognizing the limited influence of an individual's past, field theory demands a much sharper analytical treatment of historical and developmental problems that is customary, particularly in the theory of associationism (ibid, pp.214-215)."

Mathematical representation of psychological situations

Lewin argues that to allow for scientific derivations, "psychology must use a language which is logically strict and at the same time in line with constructive methods (ibid, p. 215)."

Game Theory and Epistemic Games

While discussing a possible focus on career development interests with my doctoral advisor Professor Brent Wilson and mathematics professor Burt Simon at the University of Colorado at Denver (UCD), the use of epistemic games and principles of game theory for these investigations arose. My interest in game theory led me to read contributions of two Nobel prize winners in economics: A 1994 recipient, John Nash "for his pioneering analysis of equilibria in the theory of non-competitive games," and a 2002 recipient Daniel Kahneman "for having integrated insights from psychological research into economic science, especially concerning human judgment and decision-making under uncertainty." Brandenburger and Nalebuff (1996, p. 7) list several advantages that game theory has to offer including:

- "Game theory focuses directly on the most pressing issue of all: finding the right strategies and making the right decisions.
- Game theory is particularly effective when there are many interdependent factors and no decisions can be made in isolation from a host of other decisions.
- Game theory is an especially valuable tool to share with others in your organization.
- Game theory is an approach you can expand and build on."

My hunch currently is: epistemic games and game theory would be a front end for large-scale data collection, while field theory might be the background theoretical framework for addressing challenges in CBPE, CD and CM for the following reasons:

1. Current educational reform initiatives call for data-driven assessment strategies for standards- and outcomes-based curriculum.
2. There seems to be a tremendous learning opportunity, and possibilities for productive use in education with greater students' buy-in, on the emerging multi-billion dollar games software industry (BECTa, 2001) for games such as Sims, SimCity, Championship Manager, Age of Empires, City Trader and other Brain Teasing Games.
3. Instructional games could foster collaborative and/or personalized learning among stakeholders in education (particularly students and teachers).
4. Various technological (graphics, sound and interactivity), narrative (story line, curiosity, and complexity), and personal (logic, memory, mathematical skills, challenge, problem solving and visualization) aspects of games support various

cognitive strategies for learning (BECTa, 2001).

5. Instructional games need not be confined to specific learning disciplines or domains, because the structural aspect of a game motivates players.
6. Once certain concepts are identified, for instance in CBPE, CD, or CM, it might be possible to design appropriate games, which would suitably transmit these concepts to learners.

Collins and Ferguson (1993) and Morrison and Collins (1995) published seminal ideas about epistemic games. Epistemic games are general-purpose strategies (that includes setting goals, playing within the rules or constraints, making different moves and transfers to different games), for analyzing everyday phenomena and guiding inquiry. Epistemic forms are target structures (or models) that humans use to construct knowledge. The purpose of playing epistemic games is to develop or complete an epistemic form that satisfies an inquiry. The missives that I developed for learning and teaching physics, described in the next section, might be considered an example of an epistemic form. Using technology and our expertise in various subject areas, we could design epistemic games that encourage reflection, understanding, and excitement rather than impulses, rote-learning, and boredom. Science teachers, who are familiar with the 5E model, described in the section "show not tell–develop games not facts," could use this model to design epistemic games that are computer-based. The terms epistemic games and epistemic forms were derived from workshops organized by David Perkins and Allan Collins.

Epistemic games are entirely language-based. Morrison and Collins (1995) describe three ways in which technology might play a significant part in the development of epistemic fluency, “the ability to recognize and practice a culture’s epistemic games” (p. 43). They are: “(1) as communication environments, (2) as tools for constructing theories, and (3) as simulation environments to play epistemic games” (p. 43). Collins and Ferguson (1993, pp. 29-39) describe several games, from list games to trend and cyclical analysis games, much like the 17 TIPERs mentioned in the section “productive and active.” Designing and playing epistemic games might help students develop their epistemological beliefs and achieve mastery of concepts in different subjects in schools.

One of my challenges while attempting to use game theory and epistemic games will be reconciling my traditional style with an unconventional style. Epistemic games will be unconventional because teachers might seemingly give up control over learning outcomes and students would largely arrive at various epistemic forms (knowledge structures) based on their prior knowledge, needs and experience. A teacher will be merely a facilitator and in the words of Jones (2002, p. ix):

> . . . who is in charge of the mechanics of the event but has no role in trying to nudge the participants into making sensible decisions or finding the ‘right’ answers. A game or simulation in which participants make mistakes and errors of judgment is not a failed event; it is probably a highly successful event in terms of learning from experience.

Teachers, however, can bring a closure to learning by actively soliciting what students learned after playing the different epistemic games. My personal preference is to have students and teachers play such games online to record large-scale data on a database, to inform further modifications and developments. Elby (2001) argues that isolated pieces of epistemologically focused curriculum will not be enough. Teachers around the world are faced with the dilemma of "covering syllabus content" versus "facilitating student understanding." Curriculum designers and policy makers might question the trade-offs when teachers give up instructional time to activities away from the 3Rs. Interestingly, Elby (2001) observed that students exposed to such curricular reconstruction would perform well in exams that test conceptual matter in core topics rather than just content information. Almost 75 years ago, Whitehead (1929) coined a maxim "what you teach, teach thoroughly," and this cannot be more relevant today.

It is ironical, as Reiber (1995) mentions that gaming, a basic component of human interaction, has received scant interest among instructional design researchers. In my view, studying and using epistemic games and game theory in education is not envisioned as a magic wand that will guarantee success in developing higher-order cognitive skills in students. However, it appears to be an attractive framework that complements characteristics of Lewin's field theory. Moreover, continued research by a professional learning community would help uncover student difficulties and perceptions about reality. Researchers (Kafai, 1995; Reiber, 1996) have observed that by combining technology with instructional games, students learn subject content effectively.

CONCEPT-BASED PHYSICS EDUCATION

Narrative

In the beginning of my freshman year in Loyola College, Madras, India, I acquired a syllabus book for the entire undergraduate program. The book also detailed recommended texts for each course. I sought past examination papers to help me become familiar with the various topics in the syllabus. Equipped with past papers from 1960, I organized them according to topics. Then, I read several recommended texts to find answers and developed my own missives for learning. This helped me become confident and paved the way for my success in examinations, semester after semester. For convenience, I will call this style of learning, self-directed learning. I sustained this learning style diligently throughout my undergraduate course and continued with it when I started teaching science 14 years ago in middle and high schools. Rather that a "teach to the test," the approach helped me identify and explain fundamental concepts to students. Further, I understood the efficacy of this approach (using past examination papers for guiding instruction) by repeatedly seeing students' success.

In addition, when I taught physics for six years in high schools in India, I used ideas liberally from four primary sources: *Nuffield O-level Physics* (UK), *PSSC Physics*, *Harvard Project Physics*, and the *American Journal of Physics*, to excite my students. Reading the acceptance speeches by Oersted medallists–recipients of the *American Association of Physics Teachers* (AAPT) most prestigious awards for notable contributions to physics teaching, was always interesting and provided several ideas for classroom use. Some examples I used from the four sources include: experiments with equilibrium, electric circuits and graphs, Newton's third law, using Nobel laureates' work to commence my lessons, using humorous physics anecdotes in the classroom, and highlighting physics' historical development. Consequently, most students participated willingly in the classroom activities and discussions. Some students made presentations in class using "The Amateur Scientist" column of the *Scientific American*, and other journals, while others participated actively in annual inter-school physics fairs.

During eight years that I taught science and physics at Emirates International School (representing over 87 nationalities) in Dubai, United Arab Emirates, I learned that student difficulties with physics, and mathematical challenges with fractions, linear equations, ratios, and graphs, seemed universal and not unique to specific cultures. Student difficulties with problem solving in physics, often transferred by teacher's lack of subject competence (Hestenes, 1998), and difficulties with ratios (Arons, 1990), have been widely studied and well documented. Hake (1998) found compelling evidence and an increasing correlation between problem solving and conceptual understanding in physics. Dewey (1933), while articulating the significance of conceptualizing ideas, observes that concepts should be viewed as "known points of reference by which to get our bearings when we are plunged into the strange unknown" (p. 153). The renowned educationist argues that at every stage of development of young children, each lesson must lead up to "conceptualizing of impressions and ideas" (p. 158). Echoing similar ideas in *The Aims of Education*, the famous mathematician Whitehead (1929) cautioned that by loading the curriculum with inert ideas, ideas that cannot be assimilated or applied in new situations, the intellectual development and self-development of individuals is stifled.

To sustain students' attention and also motivate them to understand concepts, I often challenged the class with a "hunch" based on my experience, before I explained a physics concept. The "hunch" would be my guess about how many students might give a "wrong" answer to my question. I then explained a concept in detail with all its nuances and posed a simple question to test their understanding. Based on the number attending class, I mentally worked out an approximate number of anticipated "wrong" answers and shared the number with the students. To verify my "hunch", sometimes I went around checking the answers and at other times, I asked the students to exchange their notebooks, or report their answers honestly. I found that often, the "hunch" had been right and most students were fascinated with this game. This "game" also helped me provide instant feedback to students on their learning.

To summarize this unit, in physics education, my doctoral research will focus on studying common conceptual difficulties encountered by students and teachers, and examine intervention strategies that might help alleviate common difficulties in learning and enjoying physics.

Challenges and Needs

As a student of physics for 10 years, and a subsequent practitioner teaching and internalizing physics concepts for 14 years, these experiences have convinced me of the importance of maintaining baseline-learning standards, both for reducing student achievement-gaps and increasing teacher accountability. Common past roadblocks (Berridge, 1998; Hunt, 2000; Lerner, 1992) with several initiatives in physics during the 1970s such as the Harvard Physics Project, Physical Sciences Study Committee, and the Nuffield Physics include:

1. Modeling curriculum initiatives to cater to more able at the expense of disadvantaged students,
2. "Dumbing down" physics by diluting physics content, due to inadequate subject competence and pedagogy.
3. Lack of coordination between physics and mathematics departments to tackle

fundamental student difficulties with linear equations, algebra and graphs,

4. Overemphasizing heuristic and problem-solving techniques by playing down conceptual understanding,
5. Pursuing an almost rigid linear progression of topics, starting with "mechanics" and ending in "modern physics",
6. Expecting most learners to be comfortable with symbolic representation and the stage of formal operations before they move out of concrete operations,
7. Not providing enough time within existing school structure to integrate historical approaches to CBPE,
8. Not supporting students and teachers by offering them sufficient resources and training with concepts and strategies based on theories in cognitive development (few initiatives such as *Thinking Science*, Adey, Shayer, & Yates, 1992),
9. Not raising student awareness of the significance and exciting career opportunities open with a physics background.

Issues

Productive and Active

Physics is often perceived as a "difficult" subject. The staggering statistics quoted in a briefing paper (Miller, Streveler, & Olds, 2002) reinforces this perception. The researchers state that although 3600 published papers in their database relate to misconceptions in science and engineering education, two-thirds of them related to physics education. Other researchers have commented on the amateurish state of physics teaching (Griffiths, 1997; Hestenes, 1998). A popular instrument used to examine students' conceptual understanding of mechanics is the Force Concept Inventory

(Hestenes, Wells and Swackhammer, 1992). The force concept inventory (FCI) is currently the most widely used assessment instrument of student understanding of mechanics (Henderson, 2002). In the findings of the Modeling Workshop Project (Hestenes, 2000), high school physics instruction is evaluated with the FCI. Two of the 15 findings are interesting:

1. Students who score below a *Newtonian threshold* of 60% on the FCI do not have a sufficient grasp of principles to use them reliably in reasoning and problem solving. Moreover, they do not score well on any other measures of physics understanding even outside mechanics.
2. Only a third of the 212 teachers who have completed the full two-summer program of Modeling Workshops can be described as expert modelers, meaning that they have adopted and fully implemented the Modeling Method of Instruction with evident understanding.

The report states that the most important factor in student learning by the Modeling Method is a teacher's skill in managing classroom discourse. Even with experienced teachers, the report continues, it will take participants several years to achieve high levels of proficiency. Evidently this underscores a crisis in physics education and calls for sustained efforts to remedy deficiencies. Traditional methods of instruction during pre-service training alone will not be sufficient.

For over a decade now, physicists O'Kuma, Maloney, and Hieggelke (2000) have been presenting TIPERs (Tasks Inspired by Physics Education Research) workshops. In a recent workshop at the 125th AAPT meeting in Austin, Texas their TIPERs workshop listed 17 types of TIPERs from ranking tasks to concept oriented simulations tasks.

These TIPERs are designed to dispel student difficulties with physics concepts. Like the FCI, a conceptual survey on electricity and magnetism (CSEM) was developed to promote student understanding of concepts in electromagnetism. These physicists warn that it is often difficult to modify students' beliefs about ways in which our physical world behaves. Nevertheless, gains of TIPERs workshops participants' students on the FCI have been excellent (2000, p. ix).

The physics education group (PEG) at the University of Washington, directed by Lillian McDermott has also been conducting research to identify students' conceptual difficulties in physics for several years. *Tutorials in introductory physics* developed by McDermott, Shaffer, & PEG (2003), which uses a system of pretests, worksheets, homework assignments, and post-tests, is a "research-based iterative process" (p. iii). It seeks to direct instructional strategies to mentally engage students while learning physics. Their research has found that students' problem-solving competencies improves with qualitative understanding of physics concepts.

Wolfgang Christain at Davidson College, North Carolina developed physlets, physics applets, which are small flexible Java applets designed for science education (http://webphysics.davidson.edu). Physlets are becoming popular with physics teachers around the country for classroom demonstrations, peer instruction, and media-focused homework, and just-in-time teaching (JiTT). Using web-based assignments to provide prior preparatory material for students , JiTT is a pedagogical strategy used widely in several institutions nationwide to create active classroom experiences for students.

Epistemological studies that seek answers to question about the relationship between knower and the known are becoming popular in physics. These studies too, in my opinion, highlight the importance of career development elaborated on in the next section. According to Elby (2001), several research-based physics curricula “fail to spur significant epistemological development,” (p. S54) although they obtain measurable significant conceptual understanding. Citing previous studies, which show that epistemological competence correlates with students’ “academic performance and conceptual understanding in math and science” (p. S54), Elby describes how he taught students by starting with “real-life examples and commonsense intuitions” (p. S62), to change their “epistemological beliefs–their views about the nature of knowledge and learning” (p. S64) physics. Elby discusses how his students performed in the epistemological beliefs assessment for physical science, EBAPS, (http://www2.physics.umd.edu/~elby/EBAPS/home.htm) and Maryland physics expectations survey (MPEX). His study reports that students in two high school courses showed “favorable changes,” (p. S64) in EBAPS and MPEX after his teaching.

Although the purpose of my research is not to focus on any particular assessment measure, the Colorado State Assessment Program (CSAP) can help quantify how well students are meeting both the content and performance standards in the State. In my opinion, such a standards-based curricular design is worth school-wide (P-12) implementation, because the standards might facilitate the achievement of aims and objectives in a practical manner. The Colorado Model Content Standards for Science outlines what all students should achieve in schools. To define something operationally, we have to describe in detail how to observe or measure something. Although the various standards help us clarify what students should learn, they do not guide teachers with "how" to help students learn. To operationalize conceptual thinking in physics, I believe that developing epistemic games and using principles of game theory might be a solution worth examining. They actively promote standards 1, 2, 5, and 6.

Show Not Tell – Develop Games Not Facts

I often use analogies with my students to facilitate understanding and help achieve examination success. Winning a game of FreeCell on the computer is one of them! When one starts a new game, the screen appears daunting, much like a 2-3 hour examination, because 52 cards have to be moved to the home cell to win. However, with two traits, *confidence* and *persistence*, most games can be won with relative ease. Over the years, I used Gagne's (1985) theory of learning, as a framework to produce lesson plans, like several other instructors. This might be considered a traditional approach to deliver instruction. Gagne's theory used nine instructional events along with their corresponding cognitive processes:

(1) gaining attention (reception)
(2) informing learners of the aims and objective (expectancy)
(3) stimulating recall of prior learning (retrieval)
(4) presenting the stimulus (selective perception)
(5) guiding the learning (semantic encoding)
(6) eliciting performance (responding)
(7) providing feedback (reinforcement)
(8) assessing performance (retrieval)
(9) enhancing retention and transfer (generalization)

For example, I utilized these nine instructional events to write a sample lesson plan, available online at http://www.innathansworld.com/physics/p6heat.htm for a unit titled 'Transferring energy by heating' targeted at students in high school. It is important that students understand the concept of specific heat capacity in this unit because they are expected to apply their knowledge in various real-life situations. Again, while there are numerous links on the web, I could not find any practical application on specific heat capacity.

Another model based on constructivist philosophy of learning (where students build on prior experiences) developed by the Biological Sciences Curriculum Study (http://www.bscs.org/), is called the 5E instructional model. The 5E model, representing the words engage, explore, explain, elaborate, and evaluate (http://www.bscs.org/faq.html#6) seeks to develop critical thinking skills and students' understanding of science concepts that are enduring.

An interesting program developed by Educational Equity Concepts in 1986 called *Playtime in Science* incorporates a series of inquiry-based activities that involve children in higher order thinking skills–problem-solving, creative thinking, and decision-making (Sprung and Froschl, 1997, p. 2). The activities in the book seeks to increase involvement of all stakeholders in education in "a process where children are encouraged to wonder, question, and experiment-in short, to start thinking like scientists every day" (p. 2). These observations reinforce Dewey's (1933) observations about children's innate scientific mind quoted in the next section.

Educational reconstruction must be based on the development of innovative curriculum resources (Dewey, 1916). Hestenes' findings (2000), cited earlier, reports that although a vast majority of in-service high school physics teachers are eager to be excellent teachers, most of them are seriously under-prepared in pedagogy, physics, and technology. The previous section detailed current physics education research initiatives that might inform and guide my research. I articulated my interest to reconcile these with existing Colorado content standards for science in the State. In this section, I briefly discussed two widely used instructional design models. At the moment, students in the State are only assessed at the end of Grade 8 in science. The States' statistics for the 8th grade science results in CSAP is summarized in Table 1.

Table 1: CSAP 2000-2002 Grade 8 Science State Summary

Year	Number Students	% Unsatisfactory	% Partially proficient	% Proficient	% Advanced	% Proficient advanced	% No scores reported
2000	53878	20	31	41	4	45	4
2001	54642	18	29	43	6	49	4
2002	55421	19	27	43	7	50	4

Using these statistics, I would like to identify schools and school districts in which students' performances have increased significantly between 2000 and 2002. Along with experiences from my own practice, I would like to incorporate data from classroom observations of teachers and students in these high performing schools for designing epistemic games. Several questions come to my mind and I will list them elsewhere as my first research proposal based on this reflection manuscript.

CAREER DEVELOPMENT

Narrative

What is the relationship between physics concepts and career development of students? Unless students are helped in seeing benefits of studying physics or any other discipline in terms of their long-term career goals, they will continue to be indifferent.

Earlier, I quoted studies mentioned by Elby (2001) that show high correlations between students' epistemological beliefs, conceptual understanding, and academic performance. In the preface to the first edition of *How We Think* (Dewey, 1933), the educationist compares the uncanny resemblance of children's, curiosity, imagination, and love for experimental inquiry with an innate scientific mind. These same children when they move into middle and high school often seem to occlude this "scientific mind" and become less inquisitive. Dewey (1933) observed that this might be because "concepts were often presented that were so remote from the understanding and experience of students" (p. 154). Career development provides an opportunity for teachers to provide a contextual framework for learning. Dewey (1933) argues that, when students study subjects that are removed from their own experience they become "intellectually irresponsible" (p. 33).

As teachers, we are often confronted with the question: "why should I study physics?" or other specific subjects, from students. On several occasions, I have found this to be a strategy for work avoidance by some teenagers. Only one student in my experience asked me "why should I study physical education?" and that too because he had to satisfy external examiners from the UK to secure a passing grade in the course. Students generally seem to consider games and sports "fun" activities, although some professionals in sports have begun speaking about losing this focus. Delving into educational research during my years in Dubai and looking back at my own experience, I have come to believe that a deliberate inclusion of career development in the mainstream curriculum could form part of a school's curriculum in preparing students for adult life. According to McCormac (1991) career development (CD) refers to a lifelong learning process that empowers students in the exploration of occupational and educational opportunities and planning their career. Some reflections on this are articulated in the section "low stress high challenge." Students often start thinking about their future professions or careers when they are teenagers. It is therefore important to help them understand issues related to career development better so that they can plan forward and make informed educational and occupational choices during and after school. Doty and Stanley (1985, p. 4) quote several researches to conclude, "the sooner students are able to see themselves in a career development process, the sooner their present education will have more meaning."

Other researchers (Avent, 1988; Bandura, 1997; Dewey, 1933; Harris, 1999; Herring, 1998; Rogers, 1942; Whitehead, 1929; Zunker, 1994) have articulated similar concerns and called for a need for career development to raise student awareness on the importance of self-reflection. Bandura (1997) observes that: "the choices people make during the formative periods of development shape the course of their lives" (p. 422). Whitehead (1929) observes that in order to produce well-rounded learners, we should seek to produce men and women who possess both culture and expert knowledge in some special direction. Dewey (1933, p. 34) argues for a need to weave the "moral qualities of character" with "abstract principles of logic." By helping students achieve creditable results (unique to each student) in various academic subjects, teachers might reinforce these ideas in the minds of students.

To summarize, in career development, my doctoral research will focus on identifying key factors (such as self-efficacy, responsibility, and relationships) that might facilitate the development of self-organizing qualities in small-groups of self-directed learners (who demonstrate traits such as motivation, discipline, and risk-taking).

Challenges and Needs

Although career developoment has been widely researched, there has been a dearth of material that reflects perspectives of students. In the introduction to her book, Harris (1999) notes that a separate book will be required to present the views of students who are at the receiving end of CD. Eccles (1993, as cited in Herring, 1998) reports that adolescence represents a period of change frequently confounded by confusion and uncertainty. Other researchers, like Harris and Grede (1977, as cited in Doty and Stanley, 1985), have pointed out very serious problems in students' career choices – the mismatch between student aspirations and ability. With this background, it is evident why Hargreaves, Earl and Ryan (1996) predict that young adolescents are likely to change their career, on an average, at least five times in their lifetime.

Clearly, students and adults wish they would receive more help from their schools. The important role of their institution becomes apparent when we recognize that several students can expect little help from outside. Miller, Goodman & Collison (1991) observed in 1990 in their study to foster career development: almost 65% of those surveyed said that if they had to start their careers anew, they would get more information about their strengths, preferences, and goals in relation to work and potential career choices. This study prompted the National Occupational Information Coordinating Committee to develop the National Career Development Guidelines (NCDG) to foster career development at all levels from kindergarten to adulthood. Handy (1990) observes that the harsher realities of competition have resulted in the following situation: "No longer is there the feeling that somewhere someone is thinking about your life, watching your development, planning your next steps. It probably always was an illusion, now few ever pretend" (p. 159).

I believe that, by offering a comprehensive CD program that integrates with subject teaching and learning, teachers and schools can devise strategies that will help them demonstrate how their roles integrate with the overall goals of education. Dewey (1916) affirms that when schools actively include career development in their curriculum, they enrich the school life of students and make it "more active, full of immediate meaning and connected with out-of-school experience" (p. 369). Relying on interest inventories to help students plan their careers has not been very successful. Ghiselli (1966 as cited in Zunker 1994, p. 137) pointed out that "predicting success in occupational training programs on the basis of test results is only moderately reliable".

Other key debates identified by Feller and Davies (1999, pp. 120-121) for leadership champions who seek to further school-to-career (STC) initiatives are relevant here.

- Is STC the latest staff-developmental fad, repackaged vocational education, or a corporate effort to fortify economic productivity and social-class advantages?
- Is it an effort to embrace technology and business partnerships in the fight against educational and socioeconomic inequality?
- Can it provide access to the best educational strategies for *all* students

without threatening those now receiving an elite advanced placement education?

- Does it turn accountability to the business community's doorsteps by demanding sustained local partnerships?

The authors (Feller and Davies, 1999) raise several other debates in their paper. I proposed a need to include CD in the mainstream curriculum during my Masters thesis (Sheffield, UK) based on student perceptions without being aware of these debates. Although a novice to career development initiatives in the United States, my arguments for including STC initiatives are based on my personal reflections and experience, after teaching and observing students from over 87 nationalities.

Issues

Principles of self-organization

Students are provided a context for learning when teachers relate real-life examples and applications with classroom instruction. Developing CD skills helps teachers provide effective instructional strategies (that includes advancing students' readiness, contiguity, goal-setting, problem solving, and decision-making skills), and facilitates contextual learning. Three types of thinking: reflective thinking, critical thinking and breakthrough thinking are worth examining because of their importance to self-organized learning. Dewey (1933, p. 3) observed: "no one can tell another person in any definite way how he should think." Reflective thinking is a "kind of thinking that consists in turning a subject over in the mind and giving it serious and consecutive consideration" (p. 3). Although it seems to be disagreeable to several individuals, teachers could encourage students to think reflectively because, "one can think reflectively only when one is willing to endure suspense and to undergo the trouble of searching (ibid, p. 16)."

One of the most popular and sought after clichéd thinking skill is "critical thinking." A clear definition of this term is provided in the American Philosophical Association Delphi Report (1990): "Critical thinking is the process of purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and interference, as well as an explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based." It is an essential tool of inquiry for students and teachers. It is a pervasive and self-rectifying human phenomenon. Educating good critical thinkers means working towards this ideal.

Perkins (2000) discusses a third type of thinking called "breakthrough thinking", which is "a kind of thinking that has helped much of the world's population toward exceptional levels of comfort, health and understanding (ibid, p. 5). Using historical examples, he describes a tentative fivefold structure for breakthrough thinking: "long search, little apparent progress, precipitating event, cognitive snap, and transformation (ibid, pp. 9-10)." I believe that an awareness of a historical evolution of concepts and solutions outlined in Perkins' book will be valuable for teachers and students.

When I spoke of my interest in self-directed learning, Prof. Steven Zucker at the University of Colorado at Denver shared with me (unpublished) research his colleagues and he carried out over three years with *ClassMaps*. *ClassMaps* is a whole-class mental health consultation model that makes the social and emotional elements of classrooms "visible" so that educators can assess the impact of affective supports they provide and demonstrate relationships between these and core academic tasks of schooling. Their study reports that this classroom-centered approach has demonstrated considerably significant changes in student attitudes and influenced student learning through appropriate interventions in middle school.

Other researchers have proposed alternate models like *relational ontology* grounded in recent developments in our understanding of self-organizing systems. In this model, instruction involves establishing the appropriate field conditions or connecting the learner into a system (a set of relations) through participation (e.g., as part of a community of practice) in the service of an intention. Barab et al (1999, p. 350) observe that the type of learning that they advocate "cannot be handed to the learner whole cloth but develops itself through dynamic activity (participation) as part of a system as a whole." These ideas are similar to the ideas that Lewin (1942) articulated earlier and outlined in the theoretical framework section.

Even as I examine these models, explore how CD would facilitate contextual learning, and understand relationships between various types of thinking vital for self-organized learning, a four component model proposed by Naparstek (2002) to understand children's learning problems lends additional support to my thesis. It also blends well with Reigeluth's (1999) continuum mentioned earlier. Extending Klatzky's (1980) component model for memory to learning in schools, and his research on information processing and prosocial behavior, Naparstek argues that students must be successful in four interconnected components: paying attention, ability, effort and organization to realize their fullest academic potential. In my view, current efforts to raise achievement standards of students seem to focus on just two factors listed under "ability:" intelligence and academic skills, identified by Naparstek (2002, p. 4) in his model. The other 20 factors listed under the other three components are equally important. The importance of some of these factors: interest, poor curriculum match, self-esteem, confidence, relevance, persistence, work habits, routine and planning listed by Naparstek have been mentioned in this manuscript. The rationale for CD proposed in this study addresses these very factors.

Low Stress and High Challenge

How do individuals learn? To illustrate a personal example would be relevant here. I will narrate now my reflections on how I learned to play table tennis (TT) when I was 13. For several months, as a teenager, I observed periodically how experts in a local club played the game. I consciously resisted taking a swing at the ball for almost three months. After internalizing the various processes observed, I finally "decided" to hit the ball "flat" and generated incredible force. I never attended a coaching camp (unfortunately?), to help me develop a conventional "top spin" style, but created this indigenous style to play competitively against my opponents. Simon (2001, p. 207) observes "at least 90% of what we have in our heads is acquired by social processes, including watching others, listening to them, and reading their writings." The example of learning to play TT illustrates that even physical abilities could be learned by observation. Further, participating in several tournaments, I learned how winning often starts with a mental conception. A common joke about golf being 95% mental and 5%

physical (or in the mind) illustrates this too. In professional counseling, the term used for this process is called intentionality. According to Hockaday, Purkey, & Davis (2001) "it is the ability of individuals to link their inner consciousness and perceptions with their purposes and actions" (p. 219). Their study found that "the clearer and more specific the mental process is, the more likely it is to be acted on (ibid, p. 224)."

Along with helping students develop positive perceptions about learning in the classroom, how can teachers practically address CD issues? While discussing these concerns with Professor Rich Feller at Colorado State University, he mentioned a Canadian model called BLUEPRINT, accessible online at http://www.blueprint4life.ca Built on research over a decade and modifying the CD competency framework in the NCDG, this model not only maps career development competencies for students and adults, but also complements these with performance indicators to elaborate on these competencies. These aspects tie the BLUEPRINT model neatly with my passion for CBPE too.

Professor Feller also introduced me to *The Real Game Series* (http://www.realgame.com) that "incorporates interactive learning strategies that enhance and accelerate the acquisition of knowledge and skills. The game format brings fun, stimulation and excitement to career development activities that have traditionally been didactic, tedious and at times boring—for both students and teachers (Partnership Development, National Life/Work Centre)." I do not believe in reinventing the wheel and will seek to develop my ideas based on existing frameworks provided by some of these past initiatives. An "open source" concept that is now becoming popular to share content and ideas through the web is truly fascinating, and will enhance the quality of my research.

CLASSROOM MANAGEMENT

Narrative

How do CBPE and CD relate to CM? While instructing teacher candidates on a course in classroom management, I found a list of eight "student needs and wants" that Topper et al (as cited in Jones & Jones, 2001, p. 47) compiled from research and student interviews. I asked my students to rate these eight factors based on their own personal experiences. Although our discussions in class led us to believe that the exact ranking might be different for different groups of individuals, we had a consensus on three interdependent themes that emerged. Students' self-development was the primary theme (the top three factors in our class ranking were; unconditional love, someone who will always be your advocate; friends who care for you and you for them; and physical well-being). The second theme related directly to career development (the next three factors were; having choices and learning how to make choices; fun and challenging things to do; and a chance to master skills needed to pursue a dream, for self-advocacy, and cultural interdependence). The third theme was helping others (the final two factors were; status and a "cool" reputation; and chance to make a difference in someone's life).

In my view, the primary responsibility of a teacher in a classroom is to demonstrate leadership by providing effective instruction, which is intellectually stimulating to students. Some desired outcomes achievable by engaging students might be developing students' confidence, competencies, knowledge and skills, self-esteem, intellectual equity, and conceptual thinking in a specific subject. The challenge for us as educators is to have both students and teachers step out of their comfort zones to actively pursue such desirable outcomes. Within the framework of a standards based educational reform, teachers could motivate students to achieve beyond students' previous performance levels.

To achieve this, teachers must have a strategy for efficient management of class time to provide students with challenging learning environments. They must display a wide variety of teaching strategies to meet individual student needs and abilities. Dewey (1933, p. 36) observes that by being aware of students' past experiences, their hopes, desires, and chief interests, teachers can augment their teaching and facilitate student learning. Several studies have shown that up to 50% of class time is spent on management (Martin & Sugarman, 1993), activities other than providing instruction. Jones and Jones (2001, p. 14) observe: "numerous authors have written about the lack of meaningful academic engagement students experience at school." Students benefit more when teachers assume greater leadership roles (as defined above) within a classroom.

Martin & Sugarman (1993) define classroom management as "those activities of classroom teachers that create a positive classroom climate within which effective teaching and learning can occur" (p. 9). CM is also influenced by student behavior, school policies, and other contextual factors. In addition to instructional and environmental management competencies mentioned earlier, research (Jones & Jones, 2001) shows that positive teacher-student and peer relationships enhance teaching effectiveness significantly. Jones and Jones (2001) observe that by creating a safe and caring community of learners, we could enrich the learning experience of all our students.

To conclude, in classroom management, my doctoral research will focus on understanding how individuals who can cope with change commonly develop strategies in day-to-day decision-making. Understanding these strategies might help me raise performance levels of students and teachers.

Challenges and Needs

In earlier sections, I described why it was necessary for teachers to plan their lessons around students' needs and experiences. Over the years, I learned the art of transferring some responsibility for learning to students. My colleagues often remarked that when I walked out of the classroom, students have continued to remain engaged and worked silently on their assigned tasks. I had not carried out any empirical study to investigate why students remaining focused. According to some researchers (Clark, Davis, Rhodes, & Baker, 1996) the "classroom functions as a social system and instruction succeeds or fails according to the quality of student engagement." These researchers found that, three teachers in their study, selected from 40 fourth grade teachers, articulated clear and high expectations, constantly mediated student-centered activities, and sustained a challenging learning environment, using the momentum developed in the classroom. Through the unconditional positive regard demonstrated in their relationships with students, these teachers helped students with their identity development. In their study with high school physics instruction, (Wells et al., 1995) found that "laboratory-based, computer-enhanced, student-centered and activity oriented" teaching enhanced student participation, enthusiasm and nurtured long-term retention.

Jones & Jones (2001, p. 242) comment "educators have become increasingly aware of the relationship between motivation and behavior," and examine key factors that influence student motivation (ibid, pp. 185-242). Other challenges in classroom management include:

1. How can teachers make subject matter relevant to students needs? (Dewey, 1933; Goodlad, 1984)?
2. How might teachers help students in setting their own goals? (Goodlad, 1984; Martin & Sugarman, 1993)?
3. How could teachers vary and facilitate ways of learning using approaches that employ all of the senses (Goodlad, 1984)?
4. Would competent and confident use of media and technology by teachers in the classroom enhance student motivation and achievement, particularly the disadvantaged?

The fourth question surfaced while examining students' assessment results using Box Whiskers plots of three Grade nine classes in Spring 2002. The third quartile (representing the 75th percentile) scores of two of my classes were better than the first quartile (25th percentile) of my third class. With holidays intervening and my move to the United States in Summer 2002, I could not continue with this study (accessible online at http://www.innathansworld.com/coollinks/ttt2002.htm). However, some questions still remain. Is technology a factor that significantly affects student performance? Specifically:

1 Does the median score change appreciably with such intervention?

2 How is the inter quartile range affected with the introduction of technology?

3 Are the outliers affected by changes in instructional strategies?

As teachers, there is another challenge: where do we pitch our lessons for a diverse group of learners? Vygotsky (1978, as cited in Doolittle, 1997) has provided us with an answer, and suggested that teachers should focus on the *zone of proximal development*. That's a region (including both knowledge and skills) that students are not capable of handling on their own, but can cope with, if they have help from their teachers. By providing appropriate scaffolding for students, a low stress but high challenge classroom environment can be maintained. According to Doolittle (1997, pp. 84-85), Vygotsky also underscored the process of *internalization*, and this does not "involve merely the transferring of reality from teacher to student. Vygotsky states, that scientific or school-based concepts are not absorbed ready made. . . (ibid, p. 84)." Students must be helped with processing their classroom experience and their understanding is "actively constructed as the result of social experience (ibid, p. 85)."

Issues

Leadership And Non-Zero Sum Game

Martin & Sugarman list six common CM models. Although I believe in developing eclectic models for CM, I will briefly outline the social learning and cognitive approaches (SLaCA) model because of its relevance to this study. The SLaCA model outlined by Martin & Sugarman (1993, p. 97) operates on the belief that "learners construct their own conception of things". This constructivist model, by stressing on cognition and not behavior, requires teachers to influence "the conceptions and thinking strategies that learners use to guide their behavior", so that students might apply these principles to “solve their own problems” (Martin & Sugarman, 1993, p. 98).

The question here is can CBPE principles be applied to addressing CD issues? My hunch at the moment is, CBPE will help students develop enough confidence to apply some principles to address more generic situations, not only with physics problems but also CD issues. This seems to be an extension of Hake’s (1998) finding mentioned earlier. Another criticism that Martin & Sugarman discuss (1993) is: “learners are presumed to have the cognitive resources and skills that enable them to construct knowledge, to determine appropriate courses of action, and to adapt effectively to the demands of classroom life” (p. 115). I believe that this is the primary agenda for developing an effective CD program in schools.

While I grapple with the SLaCa model, a related aspect about the curriculum nags me constantly. This corresponds to ideas that challenge my thinking and behavior on three popular paradigms: “technical,” “practical,” and “critical” (Authors, 1997). The “technical” paradigm put forth by Tyler (1949) viewed teachers as technicians who instruct according to pre-set patterns and goals. This “Tyler Rationale” helped establish the objectives approach to the curriculum based on the behavioral psychological principles of his time, what Senge et al (2000, pp. 27-52) call the “*industrial-age system of schools and assumptions about learning*.” During my teaching career, I tended to favor the “technical” paradigm to deliver content and this reflects my positivistic scientific background. To a large extent, this approach has helped me address a problem, “I understand all the theory, but it is only the problems that I find difficult to solve,” often articulated by students studying physics. The technical paradigm eventually delivers, when the "ends" are known. It brings out best results and provides for clarity, precision and evaluation. Jon Donne said: "No man is an island, complete unto himself." Likewise, no system is so straightjacket that it does not allow for a little admixture of other means and methods.

Developing an appreciation for the humanistic vision of Maslow (1970) and Rogers (1969) helped me align with the "practical" paradigm developed in the 1970s by Schwab, Stenhouse, and others. These came to the fore during my interactions with people in schools, and I could appreciate the value of the "process" model for the curriculum. To motivate students in the classroom, I used various strategies as outlined in section 1.1. The "critical" paradigm advocated by Freire and others during the 1970s sought to transcend the achievements and limitations of the technical and the practical paradigm by encouraging teachers to examine their everyday practice from a broader historical and social perspective. Reflecting on my own practice as a teacher, I could relate to Freire's (1970) idea in *Psychology of the Oppressed*, that individuals who authentically commit themselves to the people must re-examine themselves constantly. For instance, the challenges in CBPE, CD, and CM has set me reflecting on the purpose of education and Handal and Lauvås's (1987, p. 22) observation provides an eloquent description: "It is important to have people working who are aware of the background of what they are doing, and who are able to change and adjust both their 'theory' and their practice in the light of new evidence, and reflect upon what really happens around them in the classroom, the school and society."

Leadership is essentially a non-zero sum game, because the intent is not to have some individuals win at the expense of other individuals (Barth, 1990). Furthermore, using prisoner's dilemma-type problem in game theory, teachers could be helped with identifying numerous short-term students' individual and collective perceptions and decision-making. The consequences of this will be addressed in the next section.

Looking Forward And Reasoning Back – Developing Instructional Strategy

Fully functioning persons according to Rogers (Brazier, 1993) are those who can focus on intentional change and active learning. Referring to such behavioral change, Boyatzis (2001) argues that these intentional changes take place spontaneously among groups of self-directed learners. Building on earlier models developed by Kolb, Berlew and himself, Boyatzis describes how his current theory, through a five-stage discovery process of self-directed learning, starts off finding "my ideal self" and ends in "trusting relationships that help, support, and encourage each step in the process". My first impression, with a perfunctory look at his model, transported me 15 years in time, and reminded me of Ptolemy's geocentric theory of the solar system and Hipparchus' system of epicycles, outlined in the Harvard Physics Project. Humor apart, I see tremendous value in exploring Boyatzis' theory and plan to seriously examine the value of this model during my doctoral study.

Referring to classroom management as actions that teachers might consider for planning, implementing and maintaining a learning environment in their classrooms, Jere Brophy (1999) highlights three aspects that are conducive for creating such learning environments. They are "arranging the physical environment of the classroom, establishing rules and procedures, maintaining attention to lessons and engagement in academic activities" (p. 43). By focusing on instructional strategies and engaging students in academic activities teachers can become teacher-leaders. Freiberg's (1999) challenge to "go beyond compliance and move into the realm of student involvement and self-discipline" (p. 17), might be realized by implementing smart education approach's in classrooms, which utilize instructional strategies that combine career development skills with teachers subject expertise.

Teaching might be eventually rewarding but is certainly not easy when one begins practice. While observing several teacher candidates (TCs) and clinical teachers (CTs) in classrooms, I found that the TCs were primarily focused on delivering their planned lessons. It was the experienced CTs who constantly bring closure to learning for students by relating the lessons of the day with the activity that is to follow. For instance, on one occasion, a TC had just finished a 75-minute lesson on fractions in Grade 4. At the end of the lesson (since the students were going to line up for their break), the CT asked the students sitting in groups to stand up by fractions that she called out. Only the fractions could stand and line up in the front. The students and TC caught on and the lesson quickly translated into a meaningful activity for students.

My current interest also includes a desire to identify existing short-term perceptions and decision-making of students and teachers in their classrooms. By devising methods that collect reciprocal feedback on institutional learning environments (from teachers and students) on a regular basis, leaders can slowly shift the emphasis from the current summative evaluations to periodic formative evaluations. Leaders could also use such feedback to guide long-term institutional strategies and policymaking. In my view, the focus of a leader must be on the growth and personal development of individuals involved in the process of education, through a collaborative endeavor based on “humane” values of congruence, empathy, and unconditional positive regard. According to Rogers (1969), these three personal attitudes are the necessary and sufficient conditions to facilitate learning. The relationship inventories designed by Barrett-Lennard (1962, as cited in Rogers, 1969) have found that individuals who possess a high degree of these traits score high on these inventories and are able to bring out the best in people they interact with, including classrooms. Clark’s (1996) study, quoted earlier, illustrates how one aspect, unconditional positive regard, has helped students with their identity development. Jones and Jones (2000) observations quoted before also reflects the importance of these personal attitudes of teachers.

Other researchers (Aspy, Aspy et al, 2000) state that little objective data supports Rogers’ contentions. However, Aspy et al (2000) state that using their systematic approach to help relationships in classroom teaching, “educators discovered that when they responded interchangeably and appropriately to their students, the learners had fewer discipline problems, attended schools more frequently, and earned higher gains on cognitive tests (p. 33).” Notwithstanding these conflicting viewpoints, research highlights continued deficiencies in relationship-oriented studies in learning. “The impact of relational approaches to schooling is relatively unstudied, and there are few tools available to assess empathic connectedness among students and teachers” (Zucker, 2001).

While sharing these concerns for exploring effective teaching strategies with faculty at the Equity Assistance Center of Colorado State University, Jan Perry Evenstad, shared with me the GESA (Generating Expectations for Student Achievement) model for classroom management. GESA consists of five units, each with three strands. The five units are: instructional contact, grouping and organization, classroom management/discipline, enhancing self-esteem, and evaluation of student performance. The three strands correspond to: areas of classroom disparity, interactions that depend on teacher perceptions and expectations of student's characteristics and behavior, and finally curriculum related issues that relate to increasing teachers' awareness of equity issues in instructional material and resources. Grayson (1997, p. 6), reports that GESA was conceived in 1976 and the "research findings referenced in the manual span more than seven decades. . .to remind us that this work is part of a continuum of effort (ibid, p. 9)." This is an exciting model to explore too, but I think we need CM models that consciously shy away from discipline (third area), to reflect the broader scope of CM to include instructional strategies and subject expertise.

SYNTHESIS

To conclude, I reiterate that in this era of information overload, educational organizations demand leaders who not only understand current trends in management, but also are also flexible enough to engage colleagues and institutions with policies crafted by the State and society. To achieve this, relationships in leadership are critical. Relationships help leaders provide people with appropriate resources, experiences, and information that are needed to perform better in their jobs. In practical terms, this means actively soliciting the opinions of all stakeholders in education and channeling their participation. Within a classroom context, this would imply teachers should constantly try to empower their students to learn and develop their (reflective, critical and breakthrough) thinking skills to, in the words of Carkhuff (2001, p. 248): "place the power of civilization—its freedom, its productivity, its processing—inside each individual." Consequently, this empowerment might promote learning communities in educational organizations, where members can truly share a conviction that their collective knowledge of the world will be enriched when both individuals and different members within the group share their expertise.

This manuscript briefly described similarities between Reigeluth's continuum (1999) for learning, Kurt Lewin's field theory (1942), Collins' epistemic games (1993), physics education researches and epistemological studies, BSCS's 5E instructional model for science education, relational ontology and higher order thinking skills for self organization, and the social learning and cognitive approaches for classroom management.

My research on three core ideas discussed in this manuscript will help me investigate them from a vantage point of an experienced practitioner passionate about CBPE, CD, and CM. My extensive experience with physics education will help me address challenges in CBPE. The metacognitive approach has helped me articulate my ideas on CD. Traditionally CD has been accorded a lower status from mainstream subjects. However, by seeking to integrate CD with classroom physics teaching, I believe I am exploring new ways to contribute to research in the social learning and cognitive approaches model of CM. Some existing models that interest me in these three core areas have been briefly described in this manuscript.

Even as I continue investigating problems in CBPE, CD, and CM, it might appear to some readers that this researcher has already embraced a solution, but to those skeptics I say: "Deciding upon a design solution and making decisions within that framework is a highly situated activity" (Wilson, 1995). In this case, having a community of professionals research and develop "epistemic games" seems to be holding out a lot of promise. As long as teachers and students find meaning in these activities, and work diligently toward achieving consensually agreed outcomes to learning, there is every reason to believe that engaging in this study will be productive and intellectually stimulating for all.

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