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Will You Still Be Teaching in the Twenty-First Century?

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INTRODUCTION

"Computers are coming! Computers are coming!" is the cry heard around the world as the technology revolution slowly and insidiously works its way into the classroom from kindergarten through higher education. Administrators dream about the economies of inexpensive computer systems handling hundreds of students relatively independently of faculty, with the additional benefit that computers do not debate issues at staff meetings. Lost in the current rush to extol the value of having computers in every classroom, internet courses available to any student anywhere in the world, and complete degrees offered in cyberspace, is a discussion about the real nature of education, the human side. Teaching/learning paradigms at all institutions of higher education must change from lectures to interactive, student-centered inquiry approaches, in order to focus on the human aspects of learning, or else computers will do the teaching for us.

This article is not intended to criticize all uses of technology but instead to promote learning through human interactions. The author believes that appropriate uses of technology lie in supplemental instruction intended to complement classroom activities, not replace them. Computers are useful for building skills, repetition exercises, the search for information via the world wide web, and some communications via e-mail or chat rooms. But technology can never replace the affective nature of education created by face to face interaction between students, and between students and teachers. Unfortunately, the real value of computers as teaching tools has been lost on administrators who only see the apparent economics of scale when they consider the internet as a mechanism to recruit additional students beyond their immediate geographical region.

REDIRECTING THE DISCUSSION AND TRANSFORMING HIGHER EDUCATION

College professors are at a crossroads. We are under increasing pressure to incorporate technology into our courses and to offer extraterrestrial learning environments commonly referred to as cyberspace or internet courses. Simultaneously, we are expected to teach students how to think critically, solve problems and interact socially in preparation for the workplace. Something is missing from the discussion on how higher education should accomplish these goals. The question which should be driving this debate is not how much technology can we include in our teaching, but instead, "What is the underlying philosophy of education and the learning experience?"

Several questions spring to mind and should form the basis for discussions about the future of higher education. They are:

1. Should we facilitate learning through interactive, student-centered courses or focus on information transfer to students? Choosing the latter would enable computer companies to take over higher education teaching responsibilities through information delivery devices such as CD-Roms, the internet, and video courses. Professors would be required to spend all their time on research, thus removing them from contact with undergraduates.
2. Is education a matter of convenience of time and place delivered through the use of the internet where courses can be brought right into students' homes, or should we encourage students to deal with the hard work and personal responsibilities associated with student-centered, interactive learning with their peers?
3. Should we provide our students with as much information as possible, through a professor-centered expert lecture or computer program with the student as a receptor, or should we use inquiry-based, collaborative approaches to learning which provide students with the capability and desire to understand what information they need to make a decision and how to get and use it?
4. Do we wish to create learning environments where the students never see each other or "talk" to the professor except in electronic chat rooms, or

should we focus on harnessing the power of learning though social interactions within the classroom and outside of the class?

5) Can computers present lectures more effectively than professors by using self-paced programs, interactive computer activities, and interesting multimedia elements?

TECHNOLOGY: BOON OR THREAT TO TEACHING IN HIGHER EDUCATION?

The writer believes that the rush, throughout the world, to infuse technology in every course and provide asynchronous internet courses to all students seriously threatens the social aspects of learning and the need for human interaction in the learning process. Collaboration in learning assists students in becoming productive members of the various academic, social and workplace societies they wish to join. For example, people become mathematicians, historians, writers, etc., by learning the vocabulary and culture of their chosen field(s) of study. They must learn how to communicate their ideas to their peers and people outside of their field through writing and oral persuasion. The most effective learning paradigm developed to date involves argumentation, discussion, and consensus building through human interaction. Student-centered classes accomplish this in every class.

Communicating over the internet is only one small tool available to us, and, because it does not come close to providing the human interactions that classrooms do, it should not become the primary delivery system in higher education. I want to be in the classroom with my students, to observe their reactions to learning experiences. I want to observe their body language when they interact with their peers and myself. I want to have individual discussions with students in real time in order to share our experiences regarding learning and life in general. I am not impressed with internet discussions where a smiley face on a computer screen replaces a real smile or capital letters are used to emphasize shouting, etc. Textural communication is unable to convey more subtle aspects of communication, such as specific student questions. One problem arises when people "talk" across a long distance networks. The computer systems occasionally and randomly slow down, so between the time a person types something in and the next person sees it several minutes may elapse, thus delaying the response. Also, the time it takes to formulate a response and type it into the computer may take several minutes versus giving a verbal response in a face to face interaction.

Cyberspace and asynchronous distance learning are being presented as the savior for all of higher education and the future delivery system for colleges and universities. What is the driving force behind the effort to infuse technology into college courses? Initially distance learning was promoted as a way of reaching a few students in remote or inaccessible locations. This is no longer the case. Economics now drives the rush to cyberspace. College administrators envision the internet as a mechanism to reach a vast pool of applicants throughout the world. As they consider the potential market available to them, the dollar signs in their eyes grow exponentially, blinding them to the real basis for learning, human interactions. The fallacy in their reasoning is that it only takes one organization or company to develop and deliver internet courses. Once that organization is established, colleges will no longer be needed to teach students. Computers and education technicians will provide the delivery of course content, exams, paper grading, chat rooms, etc. Technicians will be hired as tutors instead of faculty. The real drive into cyberspace then is the privatization of higher education through corporate America.

In Digital Diploma Mills Parts 1-3 (1993), David Noble, a professor at York University, Toronto, Canada, documents the attempt by large technology corporations to take over undergraduate teaching at colleges and universities. He states: "Recent events at two large North American universities signal dramatically that we have entered a new era in higher education, one which is rapidly drawing the halls of academe into the age of automation." Professors at York University, Toronto, went on strike for two months to secure contractual protections regarding distance learning and technology. Also, the administration at UCLA unilaterally instituted a policy whereby all professors were required to incorporate web sites into their arts and sciences courses. This was done over the summer when most professors were not on campus. A virtual degree is available through Arizona University, and consortiums have been developed through the Western Governors Association and the California Board of Higher education to broker Internet courses. Noble has identified the key issue:

> "Thus, at the very outset of this new age of higher education, the lines have already been drawn in the struggle which will ultimately determine its shape. On the one side university administrators and the myriad commercial partners, on the other those who constitute the core relation of education: students and teachers. (The chief slogan of the York faculty during the strike was "the classroom vs the boardroom"). It is no accident, then, that the high-tech transformation of higher education is being initiated and implemented from the top down, either without any student and faculty involvement in the decision-making or despite it. At UCLA the administration launched their Initiative during the summer when many faculty are away and there was little possibility of faculty oversight or governance; faculty were thus left out of the loop and kept in the dark about the new web requirement until the last moment. And UCLA administrators also went ahead with its Initiative, which is funded by a new compulsory student fee, despite the formal student recommendation against it. Similarly, the initiatives of the York administration in the deployment of computer technology in education were taken without faculty oversight and deliberation, much less student involvement." (p. 1)

It is clear that there is an effort being undertaken to commercialize higher education, not just transform it by the infusion of technology. Noble hypothesizes that technology represents the second phase of this commercialization. The first phase took place starting in the mid-1970's and involved commercialization of course content through research, patents, textbooks and degree requirements. The second phase was initiated when industry realized that information creation and use would be the next major commodity and that knowledge-based industries, such as colleges and universities, would be the next major economic area for development. Noble states:

> "Within a decade was a proliferation of industrial partnerships and new proprietary arrangements, as industrialists and their campus counterparts invented ways to socialize the risks and costs of creating this knowledge while privatizing the benefits." (p. 2)

> "Class sizes swelled, teaching staffs and instructional resources were reduced, salaries were frozen, and curricular offerings were cut to the bone. At the same time, tuition soared to subsidize the creation and maintenance of the commercial infrastructure (and correspondingly bloated administration) that has never really paid off. In the end students were paying more for their education and getting less, and the campuses were in crisis." (p. 2)

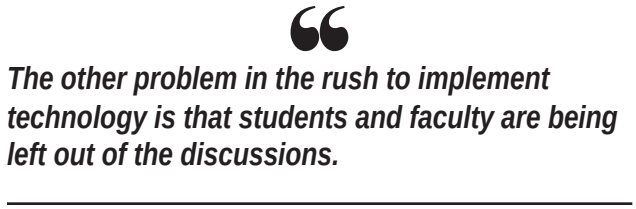
> "The second phase of the commercialization of academia, the commoditization of instruction, is touted as the solution to the crisis engendered by the first. Ignoring the true sources of the financial debacle—an expensive and low-yielding commercial infrastructure and greatly expanded administrative costs—the champions of computer-based instruction focus their attention rather upon increasing the efficiencies of already overextended teachers. And they ignore as well the fact that their high-tech remedies are bound only to compound the problem, increasing further, rather then reducing, the costs of higher education." (p. 2)

Who is behind the effort to commercialize college instruction and materials? Noble identifies four special interest groups behind this effort. The first are the vendors of the computer software and hardware. The second are corporate training advocates who view training from an economical high speed, highly specialized perspective. Third are the university administrators who wish to be considered up to date with the most modern educational systems. Fourth are the technological "zealots" who view computers as the solution to every problem and simply enjoy working with them.

What are the implications of this attempt to shift learning onto computers and the Internet? There will be a shift away from the classroom and contact with other students and the professor toward anytime, anywhere learning. Technology will mean the extension of working time since the professor can be reached by e-mail twenty four hours a day, and students will expect quick responses. Classes may be administratively monitored more closely through record and data keeping by the computers. Once courses are on the com-

puter, the originating professor will no longer be needed. These negative consequences in part explain the strong reaction by the professors at York University. The other problem in the rush to implement technology is that students and faculty are being left out of the discussions. Perhaps administrators understand the potential negative consequences of the misuse of technology and therefore make every effort to utilize the power of their positions to implement technological strategies without input from the very constituencies who will be most effected.

In a follow-up article to Noble's article, Michael Margolis (1997) clearly identifies the driving force behind the commoditization of university instruction and the consequences this will have on the future of teaching in the university. Margolis states the " Market capitalism, not the Internet per se, is the force behind developing the wired university." He believes that students will embrace distance learning because of the financial benefits they will receive, partially through reduced tuition and elimination of other expenses associated with taking courses on college campuses. He states, "A college degree from an accredited program will suffice—the cheaper the better—as long as it increases a student's chance of securing a decent first job to help pay back his or her loans. The "hightech" universities of the next century will be hailed as yet another triumph of the free market." (p. 1)



The other problem in the rush to implement technology is that students and faculty are being left out of the discussions.

In order to achieve economic nirvana universities will need to implement actions to save money. Margolis states, "With proper planning, the savings generated from eliminating lecture halls, classrooms, and most undergraduate laboratories should be second only to those realized from downsizing faculty and outsourcing courses." (p. 2) In addition, costly libraries and computer centers can be eliminated by using online, digitized libraries accessible through the internet. The true intent of the technology companies is captured by Margolis in the following quotes.

> "The beauty of this power emerges not merely from customer convenience, however. It offers better quality instruction as well. As the Internet reaches a global market, local universities no longer need to limit their course instruction to their own—and let's face it—sometimes mediocre faculty, instead, they can offer choice among the world's greatest instructors online.
>
> "Once arrangements for outsourcing the desired courses have been made with the managers and instructors at the appropriate institutions, local universities can effectively become franchises of greater institutions. They can offer their customers the finest courses of instruction from Harvard, Oxford or Heidelberg, or if their customers so desire, from Hillside, Liberty Baptist or Motorola. And, because they won't need to maintain many faculty to teach on their own campuses, they can offer these courses at a fraction of their present cost. The market will determine the best courses to offer, and the economics of scale will afford even greater savings." (p. 3)
>
> "To sum up, then, the commodification of higher educational training provides the impetus for reform of costly practices of American universities. To survive in the global market universities need to implement four types of reform:
>
> 1. downsizing faculty by replacing classroom lectures with both asynchronous and simultaneous sessions on the Internet;
> 2. minimizing the need for instructional laboratories, lecture halls, and other physical spaces for teaching on campus;
> 3. cutting research costs through the use of digital libraries and networked computers, eliminating valueless scholarship, and charging a fair price for support services that universities formerly gave for free;
> 4. ending tenure as we know it and using appropriate economic criteria to evaluate each professor's teaching, research and community service.

> Finally, universities can supplement these reforms with expanded investment in recreational facilities and in varsity athletic enterprises." (p. 6)
>
> "In order to succeed with implementing all of these reforms, university managers will have to overcome the troglodytes who resist marketing higher education as a commodity. These reactionaries argue that education in the arts and sciences is also an experience that provides worthwhile non-material benefits that enrich a person's time, and they often cite philosophies of education that run back at least to Thomas Jefferson. In the global economy, however, customers see higher education as training and credentialing to secure jobs that provide better remuneration. The American public understands that every major endeavor—with the possible exception of religion—needs to be evaluated on a commercial basis." (p. 6)

ALTERNATIVES TO LECTURING: INTERACTIVE, STUDENT-CENTERED, INQUIRY LEARNING

Lecturing is used by most professors in higher education as their principal teaching strategy. This has created the rationale for replacing lectures with information delivered by computers. If we can replace professors with teaching assistants in recitation sections, then the next step is easy, replace professors with videos of the one best lecturer and use computers and technology assistants as backups. Aside from threats of obsolescence, pedagogically lecturing is a flawed approach to teaching and must be replaced by more effective teaching paradigms. David Johnson et al (1998) have identified six specific pedagogical problems associated with lecturing. They are:

1. Students' attention to what the lecturer is saying decreases as the lecture proceeds. Students concentrate and assimilate material for 10 minutes, whereupon their attention falls off rapidly.
2. For a lecture to be effective, it takes an educated, intelligent person oriented toward an auditory learning style.
3. Lecturing tends to promote only lower-level learning of factual information.
4. Lecturing is limited by the assumption that all students need the same information presented orally at the same time and at the same pace, without dialogue with the presenter, and in an impersonal way.
5. Students tend not to like lecturing.
6. Lecturing is based upon a series of assumptions about the cognitive capabilities and strategies of students. It assumes that all students learn auditorially, have high working memory capacity, have all required prior knowledge, have good note-taking strategies and skills, and are not susceptible to information processing overload.

It is clear that the simple transmission of information through a lecture is not an effective approach to meeting the goals of helping students become independent, critical problem solvers, able to interact with their peers in social and employment situations.

The Boyer Commission (1998), sponsored by the Carnegie Foundation for the Advancement of Teaching, spent several years analyzing research universities. Their efforts resulted in a report titled Reinventing Undergraduate Education. The report is highly critical of the current undergraduate teaching approaches at universities. It identified changes that have taken place in research universities which will require changes in how those institutions view education and teaching. The Boyer Commission does not address content issues but instead draws a general conclusion about the need for research universities to re-evaluate their teaching paradigms. In order to accomplish this, the report recommends ten ways undergraduate education must change to meet the needs of our students, society and the work place. The report calls for inquiry-based collaborative learning to replace lecturing as the principal educational paradigm. The report makes the following observations.

> "Dr. Boyer set the tone for the deliberations by reminding the Commission that conditions in higher education have changed significantly in recent years: the American system of higher education has become less elite; students (and parents) have developed their own, often vigorously asserted, ideas about education and credentialing rather than accepting traditional modes without question; a much greater range of undergraduate professional degrees has become available; the freshman year has too often been reduced to remediation or repetition of high school curriculum, rather than an

introduction to a new and broader arena for learning." (p. 2)

> "But, research universities share a special set of characteristics and experience a range of common challenges in relation to their undergraduate students. If those challenges are not met, undergraduates can be denied the kind of education they have a right to expect at a research university, an education that, while providing the essential features of general education, also introduces them to inquiry-based learning." (p. 3)

The Boyer Commission points out that for economic reasons universities and colleges have focused on research as their primary function and thus have failed their undergraduate populations. Tuition is a major source of support for research programs which support graduate students. Teaching is not the primary interest of university administrators, leading to the conclusion that:

> "Some of their instructors are likely to be badly trained or even untrained teaching assistants who are groping their way toward a teaching technique; some others may be tenured drones who deliver set lectures from yellowed notes, making no effort to engage the bored minds of the students in front of them." (p. 5)

> "Many students graduate having accumulated whatever number of courses is required, but still lacking a coherent body of knowledge or any inkling as to how one sort of information might relate to others. And, all too often they graduate without knowing how to think logically, write clearly, or speak coherently. The university has given them too little that will be of real value beyond a credential that will help them get their first jobs. And with larger and larger numbers of their peers holding the same paper in their hands, even that credential has lost much of its potency." (p. 5)

> "The primacy of research within the espoused missions of American universities is attested over and over within the academic world. The standing of a university is measured by the research productivity of its faculty; the place of a department within the university is determined by whether its members garner more or fewer research dollars and publish more or less noteworthy research than other departments; the stature of the individual within the department is judged by the quantity and quality of the scholarship produced. Every research university can point with pride to the able teachers within its ranks, but it is in research grants, books, articles, papers, and citations that every university defines its true worth. When students are considered, it is the graduate students that really matter; they are essential as research assistants on faculty projects, and their placement as post-doctoral fellows and new faculty reinforces the standing of the faculty that trained them. Universities take great pleasure in proclaiming how many of their undergraduates win Rhodes or other prestigious scholarships and how many are accepted at the most selective graduate schools, but while those achievements are lauded, too many students are left alone to pursue them. And the baccalaureate students who are not in the running for any kind of distinction may get little or no attention." (p. 6)

What then is the answer to changing the environment of the university? The Commission suggests that,

> "The ecology of the university depends on a deep and abiding understanding that inquiry, investigation, and discovery are the heart of the enterprise, whether in funded research projects or in undergraduate classrooms or graduate apprenticeships. Everyone at a university should be a discoverer, a learner. That shared mission binds together all that happens on a campus. The teaching responsibility of the university is to make all its students participants in the mission. Those students must undergird their engagement in research with the strong "general" education that creates a unity with their peers, their professors, and the rest of society." (p. 7)

In addition,

> "Undergraduates who enter research universities should understand the unique quality

of the institutions and the concomitant opportunities to enter a world of discovery in which they are active participants, not passive receivers. Although shared knowledge is an important component of a university education, no simple formula of courses can serve all students in our time. Collaborative learning experiences provide alternative means to share in the learning experiences, as do the multitudinous resources available through the computer. The skills of analysis, evaluation, and synthesis will become the hallmarks of a good education, just as absorption of a body of knowledge once was. (p. 8)

The commission states emphatically that undergraduate education will need to change to inquiry-based paradigms and move away from the lecture format of classes.

"The inquiry-based learning urged in this report requires a profound change in the way undergraduate teaching is structured. The traditional lecturing and note-taking, certified by periodic examinations, was created for a time when books were scarce and costly; lecturing to large audiences of students was an efficient means of creating several compendia of learning where only one existed before. The delivery system persisted into the present largely because it was familiar, easy, and required no imagination. But education by inquiry demands collaborative effort; traditional lecturing should not be the dominant mode of instruction in a research university.

The experience of most undergraduates at most research universities is that of receiving what is served out to them. In one course after another they listen, transcribe, absorb, and repeat, essentially as undergraduates have done for centuries. The ideal embodied in this report would turn the prevailing undergraduate culture of receivers into a culture of inquirers, a culture in which faculty, graduate students, and undergraduates share an adventure of discovery." (p. 11)

"

As a pedagogy, CL involves the entire spectrum of learning activities in which groups of students work together in or out of class.

IDENTIFYING THE IMPORTANCE AND VALUE OF STUDENT-CENTERED LEARNING BY ANALYZING COOPERATIVE LEARNING PARADIGMS

We in higher education cannot compete with the big computer software companies in the production of technology oriented bells and whistles meant to enliven the transfer of information to students. We can compete by changing our pedagogy by moving away from the lecture format and making the students the center of the learning experience.

There are many interactive learning paradigms which could be used to create student-centered courses, giving professors a choice in their approaches to teaching. Cooperative learning, collaborative learning, problem or project base learning and inquiry-based learning are just a few of the categories of interactive, student-centered learning paradigms. Within each of these are a variety of structures available to professors. Student-centered learning is not merely a new fad or single approach to teaching that must be adopted by all professors but a philosophy which would allow professors to experiment with a variety of approaches.

As an example, cooperative learning (CL), as personal philosophy, not just a classroom technique, assumes that in all situations where people come together in groups, there are ways of dealing with each other which respects and highlights individual group members' abilities and contributions. The underlying premise of CL is based upon consensus building through cooperation by group members, in contrast to competition in which individuals best other group members. CL practitioners apply this philosophy in the classroom, at committee meetings, with community groups and generally as a way of living with and dealing with other people (Panitz & Panitz 1998).

As a pedagogy, CL involves the entire spectrum of learning activities in which groups of students work together in or out of class. It can be as simple and in-

formal as pairs working together in a Think-Pair-Share procedure, where students consider a question individually, discuss their ideas with another student to form a consensus answer, and then share their results with the entire class, to the more formally structured process known as cooperative learning which has been defined by Johnson and Johnson (Johnson, Johnson & Holubec 1990).

Nelson-LeGall (1992) captures the nature of cooperative learning when she states, "Learning and understanding are not merely individual processes supported by the social context; rather they are the result of continuous, dynamic negotiation between the individual and the social setting in which the individual's activity takes place. Both the individual and the social context are active and constructive in producing learning and understanding." (p. 52) Fogarty and Bellanca (1992) highlight the reaction that teachers have after they implement cooperative learning paradigms when they state, "Surprisingly and almost unfailingly, once the philosophical shift begins, once teachers begin implementing cooperative interactions, the evidence of student motivation becomes so overwhelmingly visible that teachers are encouraged to try more. The momentum builds for both teachers and students, and before long the "new school lecture" becomes the norm in the classroom. By then, the novelty of the models is no longer the challenge. The challenge becomes choosing the most appropriate interactive designs for the target lesson; it is choosing a design in which the final focus rests on the learner, not on the lecturer." (p. 84)

Cooperative learning is perhaps the most thoroughly studied teaching and learning paradigm (Johnson & Johnson 1989) with over 600 studies reported at all levels of education. The benefits which accrue from student-centered cooperative learning (CL) paradigms are many (Panitz & Panitz 1998, Panitz 1999). Several key benefits will be highlighted in this paper to emphasize the importance of student collaboration in the learning process.

CL DEVELOPS HIGHER LEVEL THINKING SKILLS (WEBB 1982)

Students working together are engaged in the learning process instead of passively listening to the teacher present information or reading information off a computer screen. Pairs of students working together represent the most effective form of interaction, followed by threesomes and larger groups. When students work in pairs, one person is listening while the other partner is discussing the question under investigation. Both are developing valuable problem solving skills by formulating their ideas, discussing them, receiving immediate feedback and responding to questions and comments by their partner (Johnson, D.W. 1971). The interaction is continuous, and both students are engaged during the session. Compare this situation to the lecture class where students may or may not be involved by listening to the teacher or by taking notes (Cooper, et al 1984). O'Donnell et al (1988) found that the initial benefits that accrued from a brief cooperative training experience persisted over relatively long intervals and that students trained in the dyadic cooperative approach successfully transferred their skills to individually performed tasks (McDonald et al 1985).

CL STIMULATES CRITICAL THINKING AND HELPS STUDENTS CLARIFY IDEAS THROUGH DISCUSSION AND DEBATE (JOHNSON 1973, 1974)

The level of discussion and debate within groups of three or more and between pairs is substantially greater than when an entire class participates in a teacher-led discussion. Students receive immediate feedback or questions about their ideas and formulate responses without having to wait for long intervals to participate in the discussion (Peterson & Swing 1985). This aspect of collaborative learning does not preclude whole class discussion. In fact, whole class discussion is enhanced by having students think out and discuss ideas thoroughly before the entire class discusses an idea or concept. The level of discussion becomes much more sophisticated. In addition, the teacher may temporarily join a group's discussion to question ideas or statements made by group members or to clarify concepts or questions raised by students. Nelson-LeGall (1992) comments on the value of debate in enhancing critical thinking skills in students. She states, "An awareness of conflicting viewpoints appears to be necessary in collaborative groups to engender the type of peer transactions (e.g., arguments, justifications, explanations, counter arguments) that foster cognitive growth (Brown & Palinscar, 1989)." (p. 55)

Another benefit of cooperative discussion is the effect it has on students who peer edit written work. According to McCarthey and McMahon (1992) "Research focusing specifically on revision when peers

respond to and edit writing has revealed that students can help one another improve their writing through response. Nystand (1986) found that students who responded to each other's writing tended to reconceptualize revision, not as editing, but as a more substantive rethinking of text, whereas students who did not work in groups viewed the task as editing only." (p. 19) Combining discussion with peer editing results in an important aspect of developing critical thinking skills in students.

SKILL BUILDING AND PRACTICE CAN BE ENHANCED AND MADE LESS TEDIOUS THROUGH CL ACTIVITIES IN AND OUT OF CLASS (TANNENBERG 1995)

Foundational aspects of education, the acquiring of information and operational skills, can be facilitated through the use of collaborative activities (Brufee 1993). In order to develop critical thinking skills, students need a base of information to work from. Acquiring this skills base often requires some degree of repetition and memory work. When this is accomplished individually the process can be tedious, boring or overwhelming. When students work together the learning process becomes interesting and fun despite the repetitive nature of the learning process.

Tannenberg (1995) states:

> "The most significant benefit that I have observed using CL has been for students to engage in the skills and practices of the computing discipline within the classroom. These practices include reading and understanding programs, designing and writing programs, complexity analysis, problem solving, writing proofs, scholarly debate, teaching one another, negotiating meaning, using alternate forms of representation (e.g., drawings of trees, graphs, and other data structures), and building collegial relationships. In a lecture-based setting, we are limited to the extent to which we can convey skills and practices—many of these do not lend themselves well to verbal description. And even for those that do, students appropriate such skills through active engagement, not by watching and listening. By working students can be encouraged and helped by their peers and the instructor within a small group setting, and they learn from one another by watching and imitating."

CL DEVELOPS ORAL COMMUNICATION SKILLS (YAGER 1985)

When students are working in pairs, one partner verbalizes his/her answer while the other listens, asks questions or comments upon what he/she has heard. Clarification and explanation of one's answer is a very important part of the collaborative process and represents a higher order thinking skill (Johnson, Johnson, Roy, Zaidman 1985). Students who tutor each other must develop a clear idea of the concept they are presenting and orally communicate it to their partner.

Tannenberg (1995) describes the benefit of developing oral skills which are discipline specific.

> "As in other disciplines, computer scientists use specialized language to economically and precisely communicate with one another. This involves not only mathematical symbols and programming languages, but additional terms and special uses of natural language. A consequence of having students work together in small groups is that they speak with one another and directly engage in discipline-specific language use. In trying to explain their ideas relating to the problems that they are solving, whether it be about a graph, program, algorithm, or proof, they will of necessity acquire the terms that describe these objects."

The additional benefit in having our students be fluent language users is that they can then enter into the culture of our disciplines. They will be able to understand specialized publications and talk with more knowledgeable practitioners. That is, acquiring the language of the discipline opens the portal to the vast store of knowledge within the discipline. We should therefore not minimize the value of having our students be able to talk with one another about their work in the disciplines that we teach. The social setting of CL provides this opportunity. And this is where it may be better that the students are interacting with one another rather than with experts, because they are less concerned about looking foolish, about being novices, about not being fluent in the new language and discipline, about being tourists in this foreign land—how easy it is to chat with other tourists!

CL FOSTERS METACOGNITION IN STUDENTS

Metacognition involves student recognition and

analysis of how they learn (0'Donnell & Dansereau 1992). Metacognition activities enable students to monitor their performance in a course and their comprehension of the content material. This includes detecting errors and learning how to make corrections while monitoring one's performance. Cooperative learning approaches create learning strategies which are independent of content and thus are transferable to different content areas. Cooperative learning structures encourage the development of metacognitive learning because they focus on the process of learning, which includes the evaluation of the group's work by individual group members, assessment and improvement of the social interactions which take place during cooperative activities, and efforts to make corrections in each individual's performance. The content matter is almost secondary to the learning process.

For example, Scripted Cooperation, a cooperative structure developed by O'Donnell and Dansereau (1992), includes five generic components which are helpful in the metacognition process: 1. dividing the text into discrete and meaningful sections, 2. having both members of a dyad read the text a section at a time, 3. requiring one partner to recall the pertinent details and information, 4. requiring the other partner to monitor this oral recall to detect errors and omissions (these two roles are evenly interchanged throughout the text), and 5. having both members of the dyad elaborate on this information with methods that may include developing analogies and generating images (Hertz-Lazarowitz, Kirkus and Miller (1992) (p. 7).

COOPERATIVE DISCUSSIONS IMPROVE STUDENTS' RECALL OF TEXT CONTENT DANSEREAU (1985); SLAVIN & TANNER (1979)

When students read a text together, explain the concepts to each other and evaluate each other's explanations, they engage in a high level of critical thinking. They frame the new concepts by using their own vocabulary and by basing their comments upon their previous knowledge. Thus, they construct a new knowledge base on top of their existing base. This process leads to a deeper understanding and greater likelihood they will retain the material longer than if they worked alone and simply read and reread the text. Johnson & Johnson (1979) found that engaging in discussion over controversial issues improves recall of important concepts. Ames and Murray (1982) found that discussion of controversial ideas among pairs of nonconservers on Piagetian conservation tasks improves their recall of content material.

CL INVOLVES STUDENTS IN DEVELOPING CURRICULUM AND CLASS PROCEDURES (KORT 1992)

During the collaborative process students are asked to assess themselves and their groups as well as class procedures. Teachers who are confident in themselves can take advantage of this student input to modify the makeup of groups or class assignments and alter the mix of lecture and group work according to immediate student feedback. The teacher does not have to wait until the results of the section exam are returned to make alterations which will help the students understand the material. Students who participate in structuring the class assume ownership of the process because they are treated like adults, and their opinions and observations are respected by the authority figure in the class (Meier, M. & Panitz, T., 1996).

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Marzano (1992) identifies four specific ways in which students become involved in developing class procedures when cooperative learning is the basis for class processes. The class can identify desired features of the physical environment, such as the arrangement of desks, number and type of breaks that will be taken, the display of classroom accessories—to name a few. Students can analyze the affective tone of their groups and suggest activities which will promote positive interactions or deal with conflicts or personality problems within each group. The class may be given responsibility for developing and implementing classroom rules and procedures. Students can help establish and implement rules for physical and psychological safety of their peers, such as a code of conduct which encourages students to respect each other, listen and respond attentively and generally care for their fellow students.

CL PROVIDES TRAINING IN EFFECTIVE TEACHING STRATEGIES TO THE NEXT GENERATION OF TEACHERS (FELDER 1997)

As discussed earlier, new teachers are likely to teach using the teaching style they have been exposed to during their education. The primary paradigm at universities is the lecture method combined with a competitive assessment process involving individual exams graded on a curve. If teachers had more exposure and practice using CL methods and were able to observe the significant benefits and student reactions, they would be more inclined obtain additional training and to try these techniques in their classes.

CL HELPS STUDENTS WEAN THEMSELVES AWAY FROM CONSIDERING TEACHERS THE SOLE SOURCES OF KNOWLEDGE AND UNDERSTANDING (FELDER 1997)

One reason for teacher reticence in adopting CL methods is the fact that professors have spent a lifetime developing their expertise in a subject, leading them to feel that their primary function is to impart that knowledge to their students. This, after all, is how they perceive they learned the subject material when doing their undergraduate studies. In reality, teachers become experts in their field when they teach the concepts to others and undertake research activities where they attempt to communicate their findings with their peers. Informal discussion and debate often yields more productive research breakthroughs than attending lectures.

CL approaches learning from a student-centered philosophy by encouraging students to take responsibility for their learning by involving students throughout the class and encouraging their collaboration in group efforts outside of class. The teacher serves as a resource and facilitator rather than as an expert. It is not a passive role for the teacher. CL requires a great deal of planning and preparation on the part of the teacher to develop activities which will help guide students through the curriculum. The effect is to begin to elevate students to the teacher's level and create a high expectation that they have the ability to obtain understand knowledge themselves.

CL ALLOWS STUDENTS TO EXERCISE A SENSE OF CONTROL ON TASK (SHARAN AND SHARAN)

The interactive, hands-on nature of CL exercises places the students in a position of control over the process and encourages them to take full responsibility for the outcome of particular assignments. Students receive training in social skill building, conflict resolution and team management. The locus of control is with the student because the teacher serves as facilitator, not director. Students are given a great deal of leeway to decide how they will function and what their group's product will be. CL empowers students to take control over their education.

CL PROMOTES INNOVATION IN TEACHING AND CLASSROOM TECHNIQUES (SLAVIN 1980, 1990)

Collaborative learning processes include class warm-up activities, name recognition games and group building activities, and group processing. Students work in pairs or larger groups depending upon the task at hand. Group work on content takes many forms, including pairs or groups working on individual questions, problem assignments, projects, study activities, group tests, etc. (Panitz 1996). Classes are interesting and enjoyable because of the variety of activities available for use by the teacher. In fact, collaborative learning effectively addresses the "Sesame Street" syndrome in which modern students are used to being exposed to information in short, entertaining sessions. These same students are also used to high-tech computer systems which deliver material in a variety of ways including video, text, graphical illustrations, and interactive systems. Collaborative learning effectively matches or exceeds the above approaches to learning by actively involving every student. Bean (1996) points out that CL techniques can be easily integrated with other teaching strategies.

CL ADDRESSES LEARNING STYLE DIFFERENCES AMONG STUDENTS (MIDKIFF & THOMASSON 1993)

Students working in collaborative classes utilize each of the three main learning styles: kinesthetic, auditory and visual. For example, material presented by the teacher is both auditory and visual. Students working together use their kinesthetic abilities when working with hands on activities. Verbal and auditory skills are enhanced as students discuss their answers together. Visual and auditory modalities are employed when students present their results to the whole class. Each of these learning styles are addressed many times throughout a class in contrast to the lecture format which is mainly auditory and occasionally visual.

CL ENCOURAGES DIVERSITY UNDERSTANDING (BURNSTEIN & MCRAE 1962)

Understanding the diversity that exists among students of different learning styles and abilities is a major

benefit of collaborative learning. Lower level students benefit by modeling higher level students, and they benefit by forming explanations and tutoring other students (Swing, Peterson 1982; Hooper & Hannafin 1988). Higher level students benefit by explaining their approaches. Students observe their peers in a learning environment, discuss problem solving strategies and evaluate the learning approaches of other students. Often behaviors which might appear odd when taken out of context become understandable when the opportunity is presented to students to explain and defend their reasoning. For example, Americans signal agreement by nodding vertically while students from India nod horizontally. Very little opportunity exists for students to explain their behavior in a lecture class, whereas in a CL environment discussions of this nature occur continuously. Warm-up and group building activities play an important role in helping students understand their differences and learn how to capitalize on them rather than use them as a basis for creating antagonism.

CL HELPS MAJORITY AND MINORITY POPULATIONS IN A CLASS LEARN TO WORK WITH EACH OTHER (DIFFERENT ETHNIC GROUPS, MEN AND WOMEN, TRADITIONAL AND NON-TRADITIONAL STUDENTS (FELDER 1997, JOHNSON & JOHNSON 1972)

Research into the effect of using cooperative learning with students of varied racial or ethnic backgrounds has shown that many benefits accrue from this method (Slavin 1980). Because students are actively involved in exploring issues and interacting with each other on a regular basis in a guided fashion, they are able to understand their differences and learn how to resolve social problems which may arise. Training students in conflict resolution is a major component of cooperative learning training (Aronson 1978; Slavin 1991).

CL BUILDS SELF ESTEEM IN STUDENTS (JOHNSON & JOHNSON 1989)

Collaborative efforts among students result in a higher degree of accomplishment by all participants as opposed to individual, competitive systems in which many students are left behind (Slavin 1987). Competition fosters a win-lose situation where superior students reap all rewards and recognition and mediocre or low-achieving students reap none. In contrast, everyone benefits from a CL environment. Students help each other and in doing so build a supportive community which raises the performance level of each member (Kagan 1986). This in turn leads to higher self esteem in all students (Webb 1982).

CL PROVIDES A BASIS FOR ALTERNATE FORMS OF ASSESSMENT (ROSENSHINE & STEVENS 1986) SUCH AS OBSERVATION OF GROUPS (PANITZ AND PANITZ (1997), GROUP SELF ASSESSMENT, AND SHORT INDIVIDUAL WRITING ASSESSMENTS (ANGELO AND CROSS 1993)

Collaborative learning provides the teacher with many opportunities to observe students interacting, explaining their reasoning, asking questions and discussing their ideas and concepts. These are far more inclusive assessment methods than relying on written exams only. In addition, group projects provide an alternative for those students who are not as proficient in taking written tests based upon content reproduction. Also, group tests give students an alternate way of expressing their knowledge, by first verbalizing their solution to their partner or group prior to formalizing a written response.

POLICY RECOMMENDATIONS

Administrators from the president of each college to department chairs must set a new tone in the discussion of what learning means by encouraging faculty to learn about student-centered learning paradigms and by providing the resources to make the transition from lecturing a reality. Faculty need to be encouraged to involve students in every aspect of the teaching/learning process and move away from the sage on the stage role they now play. If administrators spent half the time and energy the now use to promote technology instead to encourage faculty to use student-centered learning paradigms, we could transform our colleges and universities into true institutions of learning.

The following policies are needed for full implementation of student centered, interactive learning paradigms in our colleges and universities.

Policy 1: Support and encouragement must come from the highest policy making and financial boards and from the chief executive at the institution. Boards of trustees and presidents must embrace CL as a high system priority. They must be willing to provide the resources needed to implement CL in the form of training opportunities and materials. If possible, the CEO should participate in administrative training sessions. The CEO must provide the leadership in order to create an environment supportive of CL.

Policy 2: Teachers must be involved from the start in planning for CL and throughout the process of implementing CL in their classes. Even though the initial impetus must come from the top levels of administration, the development work must be done by the teachers and department level administrators to guarantee its effectiveness.

Policy 3: Funding must be adequate to provide for training workshops, conferences, teacher presentations at conferences and in-house, release time for initial preparation, on-campus activities, materials for use in class and continuous training.

Policy 4: Textbook manufacturers must be involved in the conversion to CL by providing supplemental materials in the form of worksheets, handouts describing group activities, and faculty training materials. Eventually professors will develop materials unique to their courses; however, this process will take several years and an interim approach is needed. Publisher materials will also help model CL handouts for teachers who are just beginning to develop their own materials.

Policy 5: A support group mechanism must be developed and encouraged to involve teachers in the initial development process and in the initial training activities. Meeting times and facilities must be provided along with mentors to help the new groups function.

Policy 6: Teachers need to be encouraged to adopt CL in a risk-free environment. The teacher evaluation process must be modified to take into account the different teaching methods used, and student testing through standardized tests must be re-evaluated. Alternative forms of assessment will have to be introduced and accepted in order to provide an accurate assessment of the outcomes of CL.

Policy 7: CL should be modelled in institutional decision making. Meetings should be facilitated in a CL manner. Few leaders appear willing to delegate the power to teachers needed to implement institutional change. If we desire teachers to delegate power to their students and give up the control afforded by lectures, then administrators must be willing to make the same changes.

Policy 8: Administrators and supervisors should be trained in CL and group dynamics (Cohen 1986) in order to be able to evaluate it and model it for the teachers. This goal can be accomplished through seminars, by observing experienced teachers, by taking courses in CL and through inservice training (Noddings 1989).

Policy 9: A CL library should be established within the institution, and materials provided by teachers should be archived for use by other teachers. Funding must be provided for training materials, books, videotapes, journals, etc.

Policy 10: Students should be involved in the process through a student council, advisory group or college committee assignments. The student leaders should receive training in CL also via workshops and in-school activities.

Policy 11: The general student population should receive training in conflict resolution, group dynamics and proper social behavior. Teachers need to be trained in these techniques also. An institutional philosophy of cooperation and conflict resolution must to be established.

Policy 12: Teacher training colleges and universities must emphasize CL as the primary teaching paradigm and hire professors who can teach using CL methodology. Teachers will follow the same model they were taught by, which explains why the lecture method is predominant. CL must be modeled in every college class in order to establish this method in teachers' minds.

Policy 13: Colleges must adopt CL as the primary learning method in order to encourage secondary and primary teachers to follow suit. Secondary teachers use the lecture format because they feel they must train their students to succeed at the college level.

Policy 14: CL must be implemented at all grade levels. College professors bemoan the fact that students weren't trained in CL at the secondary level, high school teachers criticize junior high teachers, who in turn suggest that primary teachers need to start the process. We can't wait 12 years for the first class to start using cooperative learning when they reach college.

Policy 15: Absolute grading instead of grading on a curve must be adopted by the institution, and alternate forms of assessment (such as group grades and portfolios) must be encouraged. The bell curve grading system by its very nature fosters competition, restricts collaboration, and leads to anxiety among students.

Policy 16: Curriculum planning and instruction must go hand in hand. "When a curricula is created, instruction must be considered, and when instruction is planned, curriculum materials must be appropriate for the mode of instruction" (Noddings 1989).

Policy 17: Facilities must be provided which are conducive to CL. Lecture halls with fixed ampitheater type seating makes student interaction difficult. Rows of desks neatly lined up are an anathema to CL. Moveable chairs and/or tables where students can work together must be provided. Tables large enough to seat 5 people would be ideal. Classrooms must be large enough to enable the professor to move easily about the room when interacting with the groups.

Policy 18: Teachers who are just beginning to use CL must be placed in an environment which will foster success, remove anxiety producing environments and encourage a major change in teaching style. In order to accomplish this financing must be provided to maintain small class sizes.

In conclusion, as we enter the 21st century professors will be forced to change from the comfortable and familiar lecture style of teaching to a student-centered cooperative mode if they wish to remain relevant. Technologies undreamed of even 10 years ago will usurp the factual, mechanical information delivery systems exemplified by the lecture, making the "talking head" professor obsolete. However, machines will never be able to replace what makes up the heart of the education experience: the development of seasoned, critical reasoning and thinking skills, obtained through face to face discussion, disputation, and deliberation with other living human beings. The cooperative classroom is ideal for fostering these types of experiences.

From the Editor: Your responses are invited, either as an independent article or as a letter to the editor to be published in Issue #24.

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"There comes a time when the mind takes a higher plane of knowledge but can never prove how it got there."
--Albert Einstein