Learning First

In

Higher Education

Aaron N. Moen

Comments from former students...

This book describes a learning environment unlike any other I encountered in college. The shared learning among undergraduates, graduate students and faculty gave me new perspectives on teaching philosophies. I gained a solid academic background while developing technical writing, editing, and public speaking skills. The team leadership and project participation opportunities have been invaluable in my career. (DM, consulting firm)

As a graduate student I found the interdisciplinary approach described in this book to be vibrant and invigorating. All students, freshman through doctoral candidates, were challenged to learn to solve problems and create knowledge together. Professor Moen's approach to education prepared students to be life-long learners. (MR, federal ecologist)

I learned from Professor Moen that I was responsible for my own learning, for finding information, evaluating it, and using it properly. I didn't know how to handle this at first but now I credit my experience in this learning environment for success in my career. (KH, research associate)

The learning environment described in this book gave students meaningful opportunities to apply what they learned by working with and teaching other students. These opportunities made students responsible for their learning while providing opportunities to practice the cooperative skills needed as professionals. (RK, law student)

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Aaron N. Moen

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PREFACE

This book is the writing of a practicing educator for 40 years. After 5 years of high school teaching, I joined the faculty of Cornell University in 1967 and began doing what most professors did ...give lectures. When course enrollment increased from 30 to over 150 in four years, I might have felt successful but instead I felt frustrated. I was lecturing to the students but I was not working with them. After returning from a sabbatical in 1974 I changed the format of my course in wildlife ecology and set up a little learning center with programmable calculators. That was the beginning of 25 years of experimenting with higher education that culminated in the design of a Cooperative Learning Center in the Department of Natural Resources in the 1990's.

This book shares some philosophy, experiences and conclusions accumulated since graduating from college in 1958. The conclusion that looms the largest is that *"learners are happiest when they are actively involved in meaningful learning experiences."*

As a competitive self-motivated learner, it took me many years to realize that learning is a social experience learning for most people. When I began to discuss learning philosophies with my two most valuable colleagues—my wife and our daughter, both of whom were elementary school teachers—I began to realize that first graders and college students are not very different when it comes to basic learning premises. *Whatever the age, we all learn best when we are actively involved in and assume responsibility for our own learning.*

I hope this book will help identify some of the characteristics of a learning environment that make learning fun and rewarding. I also want to share with readers my observation that college students are far more capable of learning on their own and with others than they generally get credit for. They are not empty vessels to be filled, but are ready and willing to be productive learners willing to share their knowledge with others.

With the appearance of powerful desktop computers, students can write better and solve more complex problems than ever before, and they should learn to share their knowledge with others. A technological revolution has taken place and I was an early adopter. Educators must be careful, however, to use the computer to enhance thinking and promote creativity rather than doing the same things that were done in the last century only "slicker and quicker."

We now live in the information age and that requires new approaches to education at all levels. The information processing power we now have at our disposal is so powerful and became available so fast, educators cannot be expected to use it to it's full advantage yet. *We will all have to become life-long learners in the 21st century.*

Acknowledgements

I first want to thank my education-oriented family for surrounding me with positive attitudes about learning. Having parents encourage me to learn both naturally and formally, three sisters and a brother-in-law in education, a wife and daughter who were elementary school teachers, and having four children with one or more advanced degrees...learning is what we do. I have learned much about computers, modeling, and resource ecology and management from our three sons. I also want to thank Lindy Kubecka for editorial assistance as this book was prepared in final form. I am also grateful for the freedom and flexibility to experiment while a professor at Cornell University. Some things worked and some didn't, but failures are stepping-stones to success. My graduate teaching assistant, G. Scott Boomer, and my two other graduate students in the 1990's, Michael Runge and Jennifer Fazzari, contributed greatly to the success of this learning environment. I especially want to thank the many undergraduate students who not only embraced a new learning paradigm but also contributed to its success by their participation as productive students and undergraduate teaching assistants. I would like to name each one of you individually, but every undergraduate contributed to my thinking and to the learning environment, and each one of you knows who you are. Going back further in time, it is appropriate to acknowledge the students who I had in junior and senior high school 40 years ago because they too contributed to my practicing the arts of teaching and learning. Reviewing the changes in my perspectives over the years, they can be summed up by...

learning first and teaching second.

About the Author

Dr. Aaron Moen, Professor Emeritus at Cornell University, began his career as a junior and senior high school teacher in Minnesota in 1958. He joined the faculty of Cornell University as an Assistant Professor in 1967 and retired in 1998. He holds a B.S. degree from Gustavus Adolphus College (1958), the M.S. degree from State Cloud State University (1963), and a Ph.D. from the University of Minnesota (1966). Dr. Moen was elected to membership in Kappa Delta Pi and Gamma Sigma Delta, and received the Distinguished Alumnus in Education award from his undergraduate institution in 1985 and the Innovative Teacher award in 1995 from the College of Agriculture and Life Sciences, Cornell University. Dr. Moen has spoken at a number of universities, has presented papers at education and wildlife conferences in the U.S. and several foreign countries, and has authored or co-authored over 90 scientific and technical papers, a wildlife ecology text, and a 7-part series on The Biology and Management of Wild Ruminants. Professor Moen designed a Cooperative Learning Center in the Cornell's Department of Natural Resources in the 1990's, incorporating cooperative learning into a course continuum while using desktop computers to enhance student creativity and productivity. *His main goal as a professor was the professional development of undergraduates in a learning environment that promoted thinking, instilled confidence and developed problem-solving skills by providing students with professional-level experiences before they graduated and became life-long learners.*

Chapter 1
Learning First

Learning should be at the forefront of every teacher's mind. While this seems obvious, it is not always the case. Following the lesson plans in elementary schools, covering the material in secondary schools, giving required tests, maintaining discipline, and taking care of the administration of teaching all interfere with learning. In colleges and universities, professors may be more concerned with delivering information by lecturing than with the active participation of students in their learning. It is easy for educators to focus on "doing" teaching rather than on the product of effective teaching, which is learning. What students are learning is more important that what the teacher is teaching! When learning is the primary goal in a classroom, the benefits to both the students and the teacher far outweigh the benefits of simply covering the material.

LEARNING IS NATURAL AND FUN!

Learning is natural. *"Learning is as natural as growing"* (Warner and Rosenberg 1976). Babies learn to cry, smile, kick, crawl, walk, run, and talk without formal instruction. Babies are curious; they look at bright objects, touch things, and put things in their mouth to experience them. *"Healthy humans are born ready to learn..."* (Perelman 1992).

It is fun to explore and discover! When babies find something new to play with, parents play with them. When they learn a new word, parents use it with them. When they

learn to do something new, parents praise them. We make learning fun for our littlest ones and we promote curiosity.

Curious minds generate ideas from experiences. Anything that changes perspectives can help generate new ideas (Hamm and Adams 1992). Professors can help make learning more natural and more fun for college students by promoting curiosity, exploration, and knowledge-sharing among the students rather than lining them up in rows and challenging them to remember what was said in lectures.

Why do students learn more when they share what they learn with others? Because sharing is so enjoyable that students want to learn more in order to share more. Sharing provides a meaningful context for learning, and learning is more enjoyable when it is relevant and talents are recognized.

College teachers, with a strong tradition for lecturing, miss opportunities to capitalize on this natural desire for learning and sharing in classroom environments because learning is usually competitive and sharing is discouraged. Yet, we all go through life living and working with others rather than by ourselves. Communicating with others, speaking to groups, making connections between groups, and working together on larger tasks are examples of life-long activities that require life-long skills. *College students experience more life-long skills in learning environments that are cooperative and social than they do in those that are competitive and antisocial.*

SOME BARRIERS TO LEARNING

A barrier to learning may be thought of as anything that prevents learners from reaching their full potential for learning. Many common barriers to learning can be identified in classrooms, laboratories, and in everyday life.

Some are mechanical, some are administrative, and some are psychological.

Mechanical Barriers to Learning

Common items can become mechanical barriers to learning. For example:

- ***Clocks…****the bell rang just when the students were discussing a great idea.*
- ***Calendars…****the semester ended just when the students started to learn in-depth about the subject.*
- ***Deadlines…****the assignment will be turned in on…but some students would like to turn theirs in earlier!*

While clocks, calendars, and deadlines may be necessary, they become mechanical barriers to learning by controlling student's time. Some thoughts about minimizing the effects of such barriers are shared in later chapters.

Administrative Barriers to Learning

All educational institutions require some kind of administrative framework. Is it possible that the traditional organization of colleges and universities may include some administrative barriers to learning? Consider the following:

- ***Departments…****colleges are usually divided into departments, and they can become little empires with their own leaders, workers, students, and resources, discouraging cooperation and integration of subjects.*

- ***Majors…****college students usually choose "majors" in larger subject areas in order to have depth, but it may limit breadth if learning in related areas is inhibited.*
- ***Courses…****college students enroll in several courses each semester, and spend their days jumping from one subject to another with little opportunity for making connections between them.*
- ***Prerequisites…****"Take statistics when you are a junior" is a barrier to learning if students should use statistics in their research project in a freshmen course. Why wait? Students should learn because they need to know rather than wait until they take "the course."*

How can departments exist as administrative units and still enable professors to recognize the connections of knowledge across departmental lines? How can courses in majors be integrated so students make connections between courses and gain the knowledge they need when they need it? More on that later, especially in Chapter 9.

Psychological Barriers to Learning

Teachers work with the most important resource that students possess—their mind. What are some of the psychological barriers to learning that may be unwittingly imposed on students?

- ***Tradition…****it is traditional to tell students to "do your own work," but isolating students from each other is a barrier to learning because, in life, people almost always have to work with other people.*

- ***Assignments…****are barriers to learning if they are without context because students lose interest when they do not see relevance in their assignments.*
- ***Grades…****grades are subjective, though they appear to be objective, and can become barriers to learning when they do not accurately represent what students have learned.*
- ***Low self-esteem…****is a powerful psychological barrier to learning; creating a learning environment where teachers, parents, and peers enhance self-esteem is one of the best ways to eliminate barriers to learning.*

How can psychological barriers to learning be removed from college classrooms when there are such strong traditions for lecturing, individual note-taking and competitive testing?

The Barrier of Fear

College professors can create fear in the minds of college students just because they are knowledgeable and in positions of power over student grades. Professors should try to recognize the potential for such fear and try to create learning environments that promote respect and success instead. What are some potential fears that may exist in the minds of college students?

- ***Fear of failure…****a student who feels inadequate is almost certain to have strong fears of failure. Teachers should promote small successes in order to help students overcome the fear of larger failures.*
- ***Fear of embarrassment…****students who fear failure also fear being embarrassed by having their failures revealed.*

Teachers should provide opportunities for students to succeed where they expect them to succeed.

- ***Fear of not being the best…****students can be so competitive that they always want to be at the top of the class. Teachers should encourage and recognize the contributions of all the students.*

Fear should be removed from learning and there should be no fear of learning because learning is natural and fun. It is so easy for teachers to tell students what they did wrong, increasing their embarrassment and fear of failure. Mistakes and failures are part of learning, and college professors should lessen student's fears by creating learning environments that emphasize the positive impacts that meaningful learning has on each student.

Other Common Barriers to Learning

Just as bacteria that have the potential to become barriers to health surround people, people are surrounded by common educational practices that can become barriers to learning. Consider the following possibilities:

- ***Student ID numbers...****students are people with names, and not knowing student's names can be a barrier to learning when students feel a lack of personal identity.*
- ***Too little teaching…****too little teaching is a barrier to learning when students receive too little orientation and encouragement from their teachers.*
- ***Too much teaching…****is a barrier when teachers do too much of the thinking and working, because students who are passively involved are missing opportunities to be active learners.*

- ***Common phrases…****"listen to the instructions"..."read pages 10-20 for tomorrow"..."the assignment is due Friday" can be barriers to learning if the teacher dominates the learning environment.*
- ***Developed resources…****the printing press is a marvelous invention, but too many reading assignments can be barriers to learning if there is too little time for creative thinking and problem-solving.*
- ***Grades assigned too soon…****receiving a poor grade before a learning cycle is complete can be a barrier to learning because being graded too soon in the learning process can discourage students.*
- ***Grades assigned too late…****receiving a poor grade after a learning cycle has been completed can be a barrier to learning because students were not motivated to work harder earlier in the learning process.*

Even tests can be barriers to learning. Test taking is a valuable learning experience when a test stimulates thinking and provides opportunities for follow-up learning. Testing procedures that cause students to react negatively create barriers to learning.

- ***Tests*** *that "screen out" students are barriers to learning for those who have been screened out.*
- ***Tests*** *that fail to measure the meaningful knowledge students have are barriers to learning because the test scores do not represent actual student achievement.*
- ***Test*** *questions that are not well understood are barriers to learning because students feel insecure and frustrated.*

Teachers work with complex and dynamic systems. Working with individual students is complex, and it is many

times more complex to work with groups of students. Barriers to learning are inevitable because teachers and students are imperfect human beings, but *reducing the number of barriers to learning is a worthy and realistic goal of every teacher.*

LEARNING WITH FEWER BARRIERS

A barrier-free learning environment is an ideal but unrealistic goal. Recognizing some of the fears that students may have and then identifying opportunities that are created by removing some of the fears is a step in the right direction.

Learning in Advance

Learning in advance means that students learn without waiting for specific assignments. Since learning is natural, learning in advance is the fulfillment of a natural tendency. Opportunities for learning in advance encourage students to take responsibility for their own learning, just as one has to do as a life-long learner. *Students should learn because they need to know rather than wait until it is taught in a course.*

Are professors uncomfortable if students learn before they have been taught, getting ahead of the professor perhaps? Some might be, because professors fear failure and embarrassment just as students do, but a learning environment in which professors and students are comfortable learning together should alleviate such fears. *What professors do about not knowing is important; students respect a professor for learning with them.*

Whether one learns in advance or waits to enroll in a course is up to the individual, but the increasing availability of information and complexity of learning suggest that the shift is logically toward learning in advance. As teachers

prepare students for learning in this new century when so much information is so readily available electronically, students should be *learning how to learn*. Not having the enabling skills for learning in advance will be a major barrier to life-long learning. *Assuming responsibility for our own learning is a compelling goal for both teachers and students*.

Promote learning!

What are some general principles that promote learning? Here are some, based on ideas in Cohen (1994), Hamm and Adams (1992), Johnson and Johnson (1994), Perelman (1992) and my own experiences in 40 years of professional involvement in education from the elementary school level to graduate study at major universities.

Learning . . .

- *Is an ongoing process from birth to death.*
- *Always occurs when interacting with others.*
- *In context is essential for problem solving.*

Students . . .

- *Can learn from each other.*
- *Can teach others effectively.*
- *Enjoy learning more when learning together.*

Cooperative learning groups . . .

- *Enhance the development of thinking skills.*
- *Promote responsibility; peer pressure motivates.*
- *Improve oral and written communication skills.*

- *Increase interest when focusing on discovery.*
- *Prepare students for personal and professional life by giving them opportunities and responsibilities for participation and decision-making.*

Learning Curves

The amount of information available and opportunities for learning have all increased greatly in recent years. Current learners need to learn how to separate useful from irrelevant information and how to synthesize new knowledge from previously existing knowledge. An ever-expanding three-dimensional knowledge domain should replace a step-like learning curve to better represent the learning needs of today's students as they prepare for the future.

CONCLUDING REMARKS

Institutions of higher learning have very strong traditions in providing instruction, and specific institutions are often known for their specific strengths. Instruction is grouped into discrete subject areas such as the arts, humanities, and science. Science is divided into natural science, physical science, and social science. Natural science is divided into subjects taught by teachers who divide the contents of their courses up further. There is a great need to make connections between subjects, however, for we all know that knowledge is connected, and many subject areas are truly related in the natural world.

"Interdisciplinary" is a current buzzword, but meaningful integration of subject areas is difficult for students. Interdisciplinary is much more than "team teaching. Interdisciplinary should mean integration of

knowledge from different subject areas, a dynamic educational endeavor that is more possible now than ever before because of the efficiency with which we can access, process, and creatively integrate information from many subject areas.

It is difficult to depart from traditions, and it is not necessary to reject all of them when creating more cooperative, experiential, and interactive learning environments for students preparing for life and careers in this new century. *Now is the time to think about some new approaches to college and university teaching because an information revolution has begun, and an education revolution will take place soon.*

A Course Continuum

Chapter 2
Learning To Learn

Learning is natural and complex. *"Learning to learn"* will become more important as mindcraft replaces handicraft as the major form of human work (Perelman 1992). Further, knowledge-based work is not just word processing, but includes information integration that becomes progressively more technical and complex as more concepts, information, problem-solving and decision-making operations are interconnected. Thinking at the current level will not solve the new problems students will face in their careers; they must learn how to learn as they face the unknown. As Perelman (1992) points out *"...work and learning are ever more convergent."*

Because specialized skills are now becoming obsolete every few years *"the prerequisite skill for a growing majority of occupations is learning to learn"* (Perelman 1992). Perelman continues by pointing out that the current education and training system largely neglects this need for *"flexible, 'on-demand,' 'just-in-time' learning..." It is important to learn how to learn in order to be a life-long learner.*

THE MEANING OF "LEARNING TO LEARN"

The meaning of learning to learn is very different today as a result of information technology than it was when learning focused on manual skills. If information is, as Perelman (1992) says *"...the closest thing we will ever have to an inexhaustible resource"* then we should learn how to use it wisely.

Preparing for Life in the 21st Century

The number of career options was limited a few generations ago. Much less information was available and technology was simple compared to what it is now. Pastoral societies and even industrial societies did not change very quickly. People learned a trade and practiced it the rest of their lives.

Expanding technology and the increasing complexity of much of what we work with makes life-long learning a necessity rather than an option in this new century. Rapid changes in information processing technology and information processing power and the potential for its creative use all continue to increase. If life-long learning is becoming a necessity, then it is also necessary for people to assume responsibility for and to learn how to manage their own learning. *College professors ought to nurture and not hinder that responsibility in their students.*

Learning in Order to Learn

Learning in order to learn and to learn efficiently on one's own will serve everyone well in the information age. With communication capabilities almost beyond imagination, we have access to so much information now that information overload can become a problem. The problem is not solved by not accessing the information, but merely accessing information is not the same as learning, however.

Learning is a cumulative process. While the human mind is a remarkable information processor, we learn rather slowly compared to the speed with which information can now be made available. Our brains do not function like servers where large amounts of information are stored and recalled in large quantities in seconds.

The need for learning is identified with the realization that *"I don't know"* and begins with *"let's find out."* We make a decision to learn when we realize there is something we do not know and we want to learn about it. We learn best when we want to learn and are actively involved in the learning process by finding out about something through research. *Research is teaching one's self.*

Most college professors have Ph.D. degrees, the highest degree awarded by universities. One of my graduate student peers asked our biology professor why he was a Doctor of Philosophy and not a Doctor of Biology. He said that philosophy meant lover of wisdom, and those who earn this highest degree love to learn. *One of our main responsibilities as teachers is to encourage students to be "lovers of wisdom," whatever degree they are working toward.*

It is interesting to philosophize about the resource—information—upon which wisdom depends. What is it? Unlike most resources which are present in finite quantities, information can be taken without being lost, it can be used by any number of people without being diminished, and it can be multiplied over and over again (Perelman 1992). Further, the value of information grows the more it is connected to other information. *Is it logical to suggest that information can lead to knowledge, knowledge can lead to understanding, and wise use of our knowledge and understanding results in wisdom?*

Growing in Many Dimensions

When students learn how to learn, they have the potential to grow in many dimensions. Some of these dimensions are…when students learn how to learn they…

- *Can find and organize information resources and educational materials.*
- *Recognize the importance of managing time, a non-renewable resource.*
- *Share their knowledge and understanding with others, gaining respect and becoming more self-confident, with higher levels of self-esteem.*
- *Are motivated to learn from within, and when learning is accompanied by success, self-motivation increases and the "feedback effect" becomes a powerful self-motivating stimulus.*
- *Learn how to evaluate and improve their own work.*
- *Realize that life-long learning is natural, just as walking and talking are natural and continue through life.*
- *Realize that life-long learning is more necessary now than ever before because rapid changes in technology make vast amounts of information readily available.*

It is very important for students to learn how to learn in order to keep up with life in today's society. College professors do not prepare students for a profession; they should be preparing students for life. *Professors should try to create learning environments that result in the most meaningful learning per unit time, and stimulate their students to want to learn and to feel good about learning.*

LEARNING BY DOING

Most teachers would agree that students learn by doing. We all learn by practicing and by applying what we have learned. Involvement is part of experiential learning; Perelman (1992) considers learning by doing an essential ingredient in hyperlearning. Quoting Perelman:

> *"The hyperlearning enterprise is a wide-open community of practice, where learning is by doing, the roles of apprentice and expert are continually shifting with the demands of the problem at hand, learning is self-paced and custom-styled by the individual learner, and passionate—sometimes 'spectacular'—learning is motivated by the natural drive of the human brain freed of the fear of failure."*

It is also important to remember that the ultimate value of what has been done lies not in the amount of effort put forth, but in the value of the product. The product may be intangible, such as an old concept or a new idea, or tangible, such as a solution to a problem or a publication. Activity alone does not guarantee productivity. *It is important that professors provide learning activities that maximize the value of the educational product.*

The common practice of having students do the same laboratory exercises year after year should be reconsidered. While it may be important that students learn the same concepts each year, the information used to illustrate the concepts can be new and different. Students can be involved in designing learning activities that illustrate important concepts. Storing current and previous work electronically, students can access a number of different designs that illustrate particular concepts. *Students can share what they learn with other students by publishing their work in electronic information systems.*

Active Learners

Young adults are active people, and activity leads naturally to learning. Cohen (1994) refers to talking, explaining, and arguing about concepts and ideas as a "*principle of adult*

learning." If that is truly a principle, and how could we argue that it is not, then shouldn't that approach be used more in higher education where learners are young adults?

When children are not active—because they watch too much television perhaps—we become concerned. Yet school children are often told to "sit down and do your work." The effect of this approach carries over into college where students often sit in a lecture room, take notes on what the professor is saying, and memorize the material for the tests.

Less active learning in higher education may be due to the tradition of large lecture classes in order to be economically efficient, even though research shows that the lecture method is not the most effective way to learn (see Bonwell and Eison 1991). Administrators should not make decisions that impede the development of life-long learning on the basis of economic expediency.

When college professors learn <u>with</u> students by being actively involved with them, their roles change from being the source of knowledge and the deliverer of information by lecture to that of <u>co-learner</u>. After I moved from the lecture format to a cooperative learning environment, two of my students shared a significant observation with me after waiting at my open door while I worked with another student. *"We wondered how you can get any work done"* one of them said, *"but then we realized that this is your work."* The truth of that observation became more obvious to me each time I reflected on my responsibility to my students, and in a research-oriented university at that. *I could even integrate my research with my student's learning when I accepted them as part of my learning environment as well as theirs.*

Creative Learners

Creative learning may result in the discovery of new concepts, but more often it focuses on the synthesis of available information in new ways for learners. Humans have unique abilities to conceptualize and synthesize, and these abilities should be developed to their maximum potential. Students who are given opportunities to think creatively and synthesize what they know about relationships and solving problems become better decision-makers.

Practice in the thinking skills listed below, based in part on a list in Hamm and Adams (1992), should be part of the learning environments of college classrooms.

- ***Focusing…****on concepts, problems, and goals.*
- ***Collecting …****what we know and what is available.*
- ***Remembering…****mentally and by data storage.*
- ***Organizing…****arranging information logically.*
- ***Analyzing…****evaluating and understanding information.*
- ***Integrating…****information and solving problems.*
- ***Producing…****composing new information from the old.*
- ***Evaluating…****both the process and product.*

Students learn to use these thinking skills by being active learners, creating new information from old information. They should be involved in their own learning rather than recording what the professor says and trying to memorize it for a test. *Thinking skills are acquired by actively creating more knowledge from previously existing knowledge.*

CONCLUDING REMARKS

The amount of learning that can be accomplished when students (or anyone!) learn how to learn is almost limitless. Students look forward to an active learning environment where they can also help others learn and share their own new knowledge with others. Their learning activities mean more to them and to their classmates when learning is shared. *Learning how to learn and being an active learner promotes the view that learning is a life-long commitment and gives individuals the skills and opportunities to carry it out.*

Chapter 3
Learning To Teach

Learning to teach sounds like a methods approach. While there are methods that make teachers more effective, the focus here is on learning in order to teach. Learning in order to teach focuses on learning that is shared with others. Since having college students share what they learn with other students is a departure from the traditional lecture approach, *learning in order to teach requires new learning models!*

LEARNING IN ORDER TO TEACH

As teachers, our goal should be as much the need for life-long learning for ourselves as we hope it is for our students. We should be continually practicing education, like medical doctors practice medicine, as we strive to structure the very best learning environment that we can for our students. As we continue to learn, we can provide our students with the benefits of our experiences as a life-long learner to motivate and interest them in becoming life-long learners.

Learning Is Modeling

Learning is modeling, and both learners and teachers can be good models. Working with curious and active learners in an interactive learning environment encourages other students to become active learners with each other. Interactive learning environments promote curiosity and further interactions among learners, as each learner is a model for others. *Learning in order to teach follows naturally.*

Learning and Teaching are Natural

As we consider the concept of learning in order to teach it is important to think about the dynamics of learning and teaching. The temptation to make teaching more formal and learning less natural is great, often in the name of "efficiency." Efficiency in learning? Usually not. Efficiency in teaching? Usually, and at the college level, most likely efficiency in delivering information to students. *Such an approach to teaching does not promote natural learning.*

Students enter college confronted by a whole new set of resources and freedoms. Astin (1993) writes *"Give…young people a good deal of freedom, coupled with some new challenges and new responsibilities, and some good things will happen...the students will seldom disappoint us."*

How willing are students to share their knowledge with other students? They are more willing to share in cooperative learning environments than in competitive ones. Students enjoy sharing their knowledge when solving problems together in small groups. Professors can be models in such a setting by working closely with groups of students rather than just delivering information to them.

If professors share what they know in natural interactive ways, their students will likely do the same. Astin (1993) points out that the extent to which a faculty is student-oriented has important positive implications for student development. By designing a learning environment that maximizes the roles of positive student models, professors promote positive peer group interactions in the classroom.

When we have in-depth knowledge of a subject, we are confident rather than hesitant when sharing our knowledge with others. When student learners feel comfortable in a learning environment that is conducive to asking questions

and sharing answers, they will also be comfortable asking questions and sharing their ideas with other students. *Students become teachers naturally in a comfortable social learning setting.*

TEACHING IN ORDER TO LEARN

What is the meaning of "teaching in order to learn" in a student-oriented interactive learning environment? Learning is natural and teaching follows naturally. Having to learn before teaching places the responsibility for learning on the future teacher, the current learner! Even experienced teachers need to keep learning in order to be effective teachers *Learning can take place without teaching, but teaching cannot take place without learning.*

Having shared knowledge with others demonstrates that we have learned it, and is one of the reasons why this book emphasizes learning and sharing—*cooperative learning*—among students. Teaching others is a meaningful review and test of ones level of understanding. It is one of the best ways for college students to reinforce their knowledge and understanding of concepts and applications.

Can professors trust students, the inexperienced learners who do not know nearly as much as professors do about a subject, to be effective teachers of other students? Yes, we can expect students to learn from other students in a learning environment that recognizes the collective knowledge the students enrolled in our courses have. *If we can't, what kind of miracle are we expecting after they graduate?*

Since professors do not know everything, demonstrating that they too are learners is a good model for the students. *"I would rather teach what I do not know than what I do know"* was one of my mottoes as a teacher because it was

more fun to solve problems with inquiring students than to just deliver information to them.

The Connectedness of Information

We all tend to make connections between what we have learned and what we are learning, but college courses are often structured in ways that isolate information more often than integrate information.

One of the criteria that I used when deciding what to share with my students was whether my experience would help them make connections faster. For example, I could relate animal behavior to physiological processes that depend on nutrition by sharing my field observations that the students had not yet observed. My students could contribute their knowledge of behavior, physiology, and nutrition to our common knowledge base. Since many of my students had just taken courses in these areas, their knowledge was surely more up to date than mine, having taken the courses 40 years ago! By integrating our knowledge we could all increase our understanding of these relationships in the natural world. *The essence of cooperative learning, of learners being teachers and of teachers being learners, is n-dimensional information transfer among all learners rather than vertical transfer from the professor down to the students.*

Sharing What We Have Experienced

Give students opportunities to teach their peers, and they will realize that <u>everyone</u> is a teacher; they are all sources of knowledge that can be shared with others. Add a generous spirit of cooperation, a heaping philosophy of learning is fun, and some catalytic activity by the professor...and a group of

learners may emerge that will surprise even the most skeptical professor!

The concept of a community of learners, a society of learners, of human beings as social creatures cannot be denied. Johnson and Johnson (1994) write: "*The human species seems to have a cooperation imperative.*" Logic suggests then that human beings learn while cooperating with others; there seems to be an educational imperative.

A diverse group of learners increases the diversity of information and knowledge being considered. Professors need to guide the learning environment so students keep on a steady course toward course goals. For example, with the vast amount of information resources available now, guiding their use is necessary to keep the community of learners from going in too many directions. There are connection limits and therefore connection priorities in a dynamic learning environment, while still encouraging creativity.

When professors share ideas, questions, and knowledge with students, they demonstrate that teaching and learning are part of a two-way street. It is better for professors to work closely with students to ensure that they have learned than it is to test them too soon to see what they have not learned.

Learning with students is enhanced when their knowledge and productivity are considered valuable resources. Think of the number of term papers that have been written, graded, and then discarded. Why ask students to use their intellect to prepare such valuable resources and then discard the product? Writing as an act of thought, and sharing writings with others is sharing thoughts with them. Students should write to learn, and their writing should be shared with other students. Publishing their writings on electronic information systems makes them available to all

of the students. Students come and go, but their work can live on!

It is the responsibility of college professors to encourage, help, and expect their students to write well. Should low grades be given until they do? No! Rather than grading their writing too quickly, editorial assistance should be given instead. What are some important things to do to help students learn to write better?

- *Praise students for good writing.*
- *Have students write less but write more carefully.*
- *Have students edit each other's writings.*
- *Help students be responsible for their writing quality.*
- *Publish their writings for the class and others to read.*

So much can be done to help students become better writers, especially now that word processing and electronic publishing available to all of us!

Students are the most valuable resources in a cooperative learning environment. They can provide editorial assistance to each other similar to the peer review process used by professional journals. Professors can work with groups of student editors to develop editorial guidelines, and students can learn to find mistakes by following these guidelines. Good examples of student writings serve as models for other students to follow. *The key is making students responsible for their own writing rather than depending on teaching assistants and professors to tell them what is wrong with it.*

Peer editing, accompanied perhaps by careful editing of a page or two of the writing of each student by the professor early in the writing process, will do wonders for student interest, writing ability, and the quality of their writing. It will also even out the workload! Students will learn about

the benefits of good time management by such a simple procedure as this, and they may even turn their papers in before the end of the semester in order to provide more time for editing by others.

When writing to learn replaces learning to write as the accepted philosophy, making what students write available to their classmates and to students for years to come is clearly a strong motivator. As one of my students wrote at the end of the semester...*"It gave me a great sense of accomplishment to hand my work in and have it published for other students to read."*

CONCLUDING REMARKS

The first three chapters of this book have set the stage for making a move toward cooperative learning in college classrooms and laboratories. The "writing to learn" discussion in this chapter is an example of the transfer of responsibility from teacher to student, with beneficial results for all. It is not a simple task, however, and the move cannot be made by a decision alone. There must be an understanding of what cooperative learning really is, of the commitment needed, and of how a transition can be made.

The next four chapters (4-7) are based on several years of design and development (Moen et al. 2000) as I moved in the direction of cooperative learning in the college classroom. By sharing my experiences with readers, the number of years it might take others to make the transition to cooperative learning (Chapter 8) might be reduced. *Making the commitment is the first step.*

Chapter 4
Learning To Interact

Learning has traditionally depended on the teaching of a teacher, and the ability of students to remember what had been taught was tested by the teacher. If students received good scores, the job was done. If not, more teaching…and eventually the students moved on to the next level.

Now, learning should involve the continuous interaction of teaching and learning. Why? Because so much of what people work with changes so fast that interaction must be continuous. Continuous with what? With information resources, because now there is no single source of authoritative information like the teacher once was. Let's look at some of the continuous interactions that are part of continuous learning.

INTERACT WITH WHAT?

What is the natural world is made of? Mass and energy that is packaged in different ways. We humans have invented languages in order to share information with others. When the information "makes sense" we call it knowledge.

Teachers should not feel responsible for as much of the information delivery now as they did in the past because information can be easily accessed by anyone. The need for information can be so spontaneous that teachers become a limiting factor if information delivery depends on the teacher. There is no longer the need to assemble classes and instruct them verbally in everything they need to know because so much is or will be available in *Information Systems*. Further, teachers do not really know what their

students will need to know in the future. So rather than teaching classes as in the past, teachers and students should interact in cooperative problem-solving environments where the focus is on learning, as Perelman (1992) suggests by the title of his book "*School's Out; Learning Is In*."

Learning to Interact with Ideas

Conceptualizing is a well-developed human ability, and much of education involves the sharing of concepts. We formulate problems based on concepts. We build objects represented first by concepts. Laws are made based on conceptualizations of human interactions and preconceived judgments of the results as good or bad for society. There are so many considerations to make in modern society that it is essential that we share concepts about how things work, from individuals to governments to global networks.

We use word and number systems to represent concepts and objects symbolically and to communicate with others about them. We do this in a verbal format by talking, by the printed word, and by schematics, pictures, animations, and real-time motion. Since we now transmit much of our information electronically and global communications are so rapid, we have essentially instant access to global information resources. Organized information becomes knowledge, and knowledge becomes meaningful when we have an understanding of relationships. Expertise is rapidly becoming less an attribute of individual persons and more a property of systems and networks (Perelman 1992).

Learning to Interact with Others

Knowledge is something to develop and share rather than be held by those in authority (Hamm and Adams 1992). The new information processing technology, referred to by Perelman (1992) as hyperlearning technology, *"...makes the very status of the individual expert obsolete."*

Two major ideas loom large in the professional literature on education: the importance of social interactions and the beneficial effects of cooperative learning. Student-peer interactions are one of the two most important factors affecting performance in college (Astin 1993), and cooperative learning environments promote peer support.

Humans are social beings with incredible potentials for social complexities. Beginning with family units and extending to world government, we socialize through biology (family systems), ethics and morals (religious systems), learning (educational systems), rules and regulations (legal systems), and trade (economic systems).

Isn't it interesting that we live in such highly developed social settings and yet traditionally line students up in rows (often arranged alphabetically), treat them as isolated individuals (do your own work), tell them what they are expected to know (you will be tested on this), and then devise artificial criteria to see who is the best!

Maybe the Johnsons (1994: 10) are right in comparing the traditional classroom setting described with Herbert Spencer's argument in the 1860's that *"...Darwin's survival-of-the-fittest concept of evolution could be transposed to human society."* There has to be a better way!

Students are willing to accept responsibility for learning when meaningful opportunities are presented to them. They probably always have been, but the urgency has never been as great as it is now when learning how to learn and life-long learning have become so necessary. *When professors give students opportunities to assume responsibility for their own*

learning, students mature more quickly than when they remain dependent on their teachers.

Summarizing the environmental effects on student outcomes in college, Astin (1993) states: "*Perhaps the most compelling generalization from the myriad findings summarized...is the pervasive effect of the peer group on the individual student's development."* Is that surprising? Hardly, when we think about the dynamic interactions among college students, of the time they spend together talking, playing, studying, sharing their ideas, commiserating together, complaining...how can curriculum structure compete with that? *Professors should design learning environments that encourage and promote positive interactions among the students in their courses.*

Learning to Interact with Tools

New tools have appeared throughout the history of mankind, but never as rapidly as electronic tools have in the last few years. With the appearance of the personal computer over 20 years ago, attention began to be directed toward information processing tools to facilitate learning. In 1995, 44,000 students from 120 countries enrolled in just one on-line course on the Internet; now there are on-line universities!

With instant access to global information resources, there is no shortage of available information. Quality and relevance are the question marks, and procedures for evaluating quality and providing access to relevant information are being developed; this new approach to information access will surely improve with experience.

When desktop computing appeared in the 1980's, I began to think a lot about how learning occurs in order to design and use the new information-processing tools to maximize learning. I tried to avoid the temptation to use the computer

to do the same things quicker and slicker, choosing rather to look for more creative ways to use its power. *Information processing tools has advanced so rapidly that educators are still learning how to use it most effectively.*

Information processing tools are now embedded in word processors, office systems, and integrated modeling environments. There are spell checkers, grammar checkers, dictionaries, language translators, databases, spreadsheets, statistical analyses, code-controlled applications...the list is long and accessible simply by clicking a mouse. Icons and pull-down menus make the right tool relatively easy to find. Given these tools, shouldn't higher quality learning be expected of students than when all writing, drawing and editing had to be done manually? Shouldn't teachers expect students to solve more complex problems? Shouldn't teachers expect students to learn how to exercise their own quality control as they use these powerful tools? If teachers do not have these expectations, then the tools available are not being used as effectively as they should be. *Teachers are responsible for incorporating the use of these quality-improvement tools into the learning environments of their students; these tools are needed for life-long learning.*

Learning to Interact with Time

We interact with time by describing happenings in units of seconds, minutes, days, years, decades, and centuries. We also interact with time by reading publications and watching movies that were written or produced earlier; the record is there for us to inspect, evaluate, and compare to current levels of thinking about ideas, concepts, activities, and life.

Evaluating written records of the thinking and actions of people in earlier societies gives students and teachers a historical frame of reference. Evaluating the historical

records of changes in social systems provides a basis for understanding current society better. Students can find information now that would have taken hours or days to find just a decade ago. They can now do computer calculations in seconds that would have taken hours or days just a decade ago. Now that students can access information almost instantly from anywhere in the world, the way students and teachers interact with each other has changed. *Electronic information processing makes our ability to conceptualize more important now than ever before.*

Having computers to find information and do routine calculations frees time for students and teachers to interact at higher levels of thinking. Teachers and students should acquire the creative enabling skills together now that the technology is so readily available. *Computers should make education more human and personal, not less.*

The new century harbors changes that can hardly be imagined. Consider the potential of virtual reality, for example (see Rheingold 1991), and I'll share an example from my field. I took my students on wilderness canoe trips in Canada, and we saw beaver lodges and crossed beaver dams. Suppose each trip could have been preceded by a virtual reality exercise that showed the students the *inside* of a beaver lodge. They would surely have had a better understanding of beaver ecology when they saw a lodge in its natural setting and we could have had more meaningful discussions of beaver ecology on-site.

Learning to Interact with Information

As learners, we are always interacting with information of some kind. Traditional information, such as written materials, will be here for a long time to come. When traditional printed information is supplemented with

electronic access to information, efficiency in accessing and processing information increases dramatically. In time, electronic access will be the norm.

The potential for interactions among information processing has reached a global scale. Educators around the world have access to the Internet, as do students in homes that are connected to on-line services. More people are signing up and more services are appearing; the global communication market is vast and is becoming more and more wireless and thereby more portable.

Imagine carrying on a dialogue with someone from another country. You do not speak their language, and their English is not very good. You write in English and they answer in their language as a computer program translates both languages! Are people patient enough to translate manually after having such an electronic option available?

The amazing advances in information processing will change higher education forever. *Mouse-power is here to stay, and it is the responsibility of professors to prepare students for the future rather than the present.*

INFORMATION NETWORKS

Information processing power will increase dramatically in the future as the connectedness of information is recognized and built into information networks. The world that current students will work in will be the product of synthesized hyperlearning technology, and *"...a new smart human environment that can observe, think, make decisions, work, converse, and learn with us."* (Perelman 1992).

Electronic calculators appeared about 40 years ago, and teachers debated whether students should be allowed to use them in class, for homework, and during examinations. Some teachers wanted to deny students the opportunity to

efficiently process the information they were trying to learn! Think of the spreadsheets and computer programs now available to students...calculating power has almost no limit!

Teaching is moving in the direction of emphasizing relationships and motivating students to become life-long learners by arousing curiosity and encouraging creativity (Hamm and Adams 1992). Having students visualize, vary, demonstrate, experiment, and simulate arouses their curiosity and encourages creativity. Working with real objects is enhanced by computer visualizations, and, for objects too small or too distant or too scarce, computer visualizations are the only way students can interact with them.

Suppose you are reading about something and would like to visualize it; click on an image icon and see the picture! Suppose you are studying history, wondering what some famous person sounded like when giving a speech; click on an audio icon and listen to the speech! Suppose you are studying animal behavior; click on a video icon and see the animal in action! *Multimedia delivers many different kinds of information rapidly and timely with just a click of the mouse!*

Integrated information systems make the connectedness of information a reality with hypertext. When students are reading about something and find a word they do not know or an idea they want more information on, they can click on the key word and its definition or additional information appears on the screen. Instant information, as Perelman (1992) points out; "*...personal learning 'on-demand,' 'just-in-time,'…*" What you need when you need it.

My students began authoring, publishing, and building hypertext and multimedia capabilities into their work in 1990. When I retired from active teaching, the *Wildlife Ecology and Management Information System* in the Department's Cooperative Learning Center contained

hundreds of files authored by my students and myself that were available through subject-related menus and key word searches. There was no more efficient way to find and work with this information than with this early integrated electronic information system. In the future "…*data storage technology…will put a lifetime of information in the palm of your hand"* Perelman (1992).

CONCLUDING REMARKS

Given instant electronic access to information, the volume of information resources available is staggering. The potential for information overload is real, however. How do we select and process the relevant information? How do teachers manage information access and application with their students, avoiding the pitfalls associated with just getting information, looking at it, and considering it "done?"

We haven't seen anything yet. I don't think many educators have truly recognized the significance of interactive learning in relation to interactive processing power available in the 21st century learning environment. Educators may not be taking enough time to think about the learning process in relation to this information processing power. *What should school be like when the bell rings 10 years from now when current students will be the teachers?*

Chapter 5
Learning to Integrate

Schools have traditionally treated learning as a "one step at a time" process. One step at a time suggests just one time dimension—now—and when you have learned it, you can move on to the next step or grade. Learning proceeds more rapidly, however, when what is being learned is related to what is already known. Relating what has been learned with what is being learned adds another dimension—the past. Thinking about future applications of the knowledge being acquired along with an understanding of relationships adds yet another dimension—the future. Thinking of different applications for solving problems in new situations, for creating new ideas from the old suggests several more dimensions. The human mind is capable of integrating a number of dimensions when it has opportunities to do so; dynamic n-dimensional learning can be a reality in the right kind of learning environment.

What skills are fundamental to the integration of knowledge and understanding? Communication is a fundamental skill. First, people used oral communication to pass their history on by storytelling, and much of our communication is still done orally. Then came written communication, using primitive pictures and scrolls first and eventually the printing press, which is still used extensively. Now we have electronic communication, making the distribution of oral and written communications extremely fast and efficient What does the future hold? More electronic communication and information transfer, for sure, and unprecedented opportunities to integrate knowledge across course and curriculum boundaries. *Learning to*

integrate knowledge and understanding effectively is becoming as essential as learning to read and write.

FROM ONE-STEP TO N-DIMENSIONAL LEARNING

Sequential learning is a useful approach to adding to our knowledge-base, one step at a time, but even young children integrate many dimensions as they learn. As the steps become more numerous and the number of relationships increases, sequential learning is replaced by n-dimensional learning. Additional knowledge then results in concomitant expansion of several knowledge domains. While simple sequential learning increases with time and can be represented by a line curving upward, n-dimensional learning is represented better by a three-dimensional expanding sphere which increases in size in several directions at once.

Logical Sequences

There are some logical learning sequences that include progressions of concept complexities and skills. We learn to crawl before we learn to walk and to walk before we run. We speak with shorter and simpler words before using longer words and complex sentences. We learn to count before we do arithmetic and trigonometry before we do calculus.

What are some examples of learning sequences in your area of expertise? In ecology, it is necessary to know the identity of a plant or animal before learning about its natural history. It is logical to know about the general natural history features of an organism before getting into some of its complex physiological functions. Behavior is often directly related to physiological functions; breeding

activities depend on hormone balances, for example. In resource management, one should understand the physiology and behavior of plants and animals before trying to manipulate their populations. Such learning sequences are logical and seamless, and should be promoted when designing learning environments. *The course continuum in Chapter 9 is an example of a seamless learning environment.*

Information can be divided into fragments that are too small to be meaningful. One approach to learning to read in elementary school was based on learning the alphabet first, then short words, followed by longer words. The sequence seemed so logical that parents were "guaranteed" that their children would learn to read. The problem was, however, that the approach fragmented the English language so much, and short words were so meaningless by themselves that the context of even simple stories was lost. *When students acquire information without a meaningful context, they may not have acquired any meaningful knowledge.*

Perceptive elementary teachers recognize that even young children have the ability to integrate knowledge. Knowledge integration depends on connecting information, a natural tendency. Elementary teachers using an integrated "whole language" approach when teaching reading and writing encourage students to write before they can read! This conceptual approach counters the argument that college students need the "minimum essentials" before they can do meaningful work in a subject. College students should learn the essentials as they use them, while integrating knowledge from relevant information resources. Creating a context for learning by integrating knowledge motivates students and has more potential for meaningful learning than the facts-first approach.

Repetitive Sequences

As soon as something meaningful is learned, a learning cycle begins and new knowledge can be created from previous knowledge. Information is used over and over again, whether it consists of words and numbers or concepts and skills as knowledge increases; integrated repetition is more valuable than meaningless out-of-context drills.

Let's think of a natural learning sequence by visualizing a group of students who have just been exposed to a new activity appropriate for their age and experience. First they observe the new activity, and then they want to try it. If it is fun and rewarding, they want to do it over and over , learning to perform the activity better as they practice regularly for a period of time. Everyone goes through such sequences when growing up. We refer to it as "play" by children and as "work" by adults, which should, ideally, be fun and rewarding like play. *How can college professors make learning fun and rewarding to the point where students want to learn because they love to learn, rather than just fulfilling a requirement for graduation?*

College students are not empty vessels to be filled by professors; they are people with knowledge and experience to build on. They are the same kind of learners they were when they were younger...curious, creative, and interactive. Professors can make learning more fun and rewarding by recognizing what their students already know, and integrating their old knowledge with the new. When students create new knowledge from previous knowledge by cooperative and experiential learning, they will enjoy enlarging their knowledge domains and sharing with other students.

N-dimensional Learning

Learning how to solve complex problems, such as nutritional ecology problems or designing a population model, is an n-dimensional task that involves conceptualizing, designing, calculating, and programming. Since computer programs often involve iteration procedures and feedback loops, learning how to write programs is more than learning a technical skill. *Programming logic requires thinking that is beneficial in many kinds of problem-solving situations.*

Learning how to solve complex problems with many dimensions may involve negotiation, where progressively focused thinking occurs until a solution is reached. Many business issues, many resource issues, and many cultural issues involve many dimensions and negotiated solutions to problems that cannot be arrived at by straight-line thinking. *Negotiation is a skill that improves with practice and cooperative learning environments provide many opportunities for that.*

Feedback is an important component of n-dimensional learning. Helping college students learn how to solve complex problems with many dimensions may involve feedback analyses where new information is used to update current information. The outcome is not the product of straight-line sequential thinking, but of n-dimensional thinking that feeds results back for further analyses. *Feedback loops and iterations, whether mathematical or verbal, are procedures that should be used by students when solving complex problems.*

Negotiation, iterations, and feedback loops were introduced above to illustrate how problems are multi-dimensional and therefore can have alternate solutions, depending on the factors considered, the design characteristics of the analyses, and the data available. Professors should not deliver solutions to such problems as

simple facts because students will not understand the factors underlying the solutions unless they become actively involved in solving such problems. *Since we cannot predict what problems students will need to solve in their lifetimes, it is far better to focus on the complexity of problem solving rather than the simplicity of factual conclusions.*

KNOWLEDGE CONNECTIONS

Knowledge implies connections, while information stands alone as facts. For example, a weight model that calculates and graphs weight patterns from conception to death at old age can be a beginning point for students to identify and understand connections that can be made to other biological processes. The output—weight—is by itself just a fact. When students learn how metabolism is dependent on weight, food intake is dependent on metabolism, food production is dependent on primary and secondary productivity, food availability is dependent on range conditions, reproductive rates of free-ranging animals are dependent on the food supply, population dynamics are dependent on reproduction and mortality, mortality is dependent on many factors that are part of community ecology...then students begin to realize how extensive knowledge is connected. *The information students learn about in any subject area is so interconnected that collaboration among learners and new learning models are not options but inevitable outcomes of logical thinking, enhanced by the information revolution.*

Creative Learning

Creative learning may result in the discovery of new concepts, but more often it focuses on the synthesis of available information in new ways. Students who have opportunities to think creatively and synthesize what they know about relationships, problem solving, and decision-making become better at it. Practice in the thinking skills listed below, based in part on a list in Hamm and Adams (1992: 114-115), help students create new information from old, or create more knowledge from previously existing knowledge.

- ***Focusing****...on concepts, problems, and goals.*
- ***Finding…****information related to the problem.*
- ***Remembering****...what we know and by data storage.*
- ***Organizing****...arranging information logically.*
- ***Analyzing****...examining and evaluating information.*
- ***Integrating****...relating information and solving problems.*
- ***Producing****...composing new information from the old.*
- ***Evaluating****...both the process and product.*

Creative Learning is enhanced by Collaboration

If there are many dimensions to learning, if learning is experiencing rather than listening, and if experiencing is an integrated complex activity, then collaboration among faculty is necessary. It is impossible for one person to know enough about all the dimensions in complex problems, the different viewpoints students should be exposed to, and the many experiences students should have when participating in the complex process of learning. *Professors should never be the limiting factor in a learning environment.*

With so much to learn, time becomes the limiting factor because professors and students cannot find the time to

explore all of the dimensions. The danger of making problems too complex also exists, but it might be better to design learning opportunities that are too complex rather than too simple.

Collaboration among learners, both professors and students, increases efficiency by making it possible to identify at least some of the many dimensions that should be considered when solving problems at the college level. Cooperation among learners increases efficiency by sharing knowledge with each other, which in turn increases understanding of the many dimensions potentially present in every learning situation. Separate courses in the traditional curriculum may be replaced by seamless courses in a continuum (see Chapter 9) in the future.

Transferring Connected Knowledge

Since academic knowledge is so connected, transferring some of it requires that the rest of it come along. Yet we can't say or write all words or all knowledge at one time. What are we to do? We have to divide the knowledge up and then put it together again. This can be done when we think of a college education as a continuum. In the past, graduates were expected to integrate what they had learned when they were on the job. Now, students should be integrating as they are learning because the task of connecting knowledge is too big to leave for their careers. Rather than expecting miracles upon graduation, let's think about how interconnected knowledge can be transferred as students learn.

Professors who deliver the information their students are to learn are demonstrating vertical transfer. The professors are likely authorities in their subject area and have in-depth

knowledge of their subject. The students will likely be lined up in rows in a lecture room while the information is delivered to them. Such vertical transfer is often accompanied by specific problems the students are to work on. Learning is directed and the subject matter is well defined and often well organized. *The material to be learned comes from the professor down to the students, with predetermined boundaries on the knowledge domain being covered.*

When students and teachers learn from each other in a cooperative setting, lateral transfer occurs. Cooperative learning depends on lateral transfer by recognizing the potential of student's prior knowledge as a basis for building new knowledge (Hamm and Adams 1992). Integration of subjects occurs naturally as more factors are brought into consideration as each person makes unique contributions. The material to be learned comes from both the professor and the students in the class, and even from professors and students who are not in the class. *Boundaries on the knowledge domain are not predetermined; learning expands as meaningful opportunities arise.*

Hamm and Adams (1992) are referring to public schools when they state "*Curriculum goals are best if they are aimed at the growth of understanding rather than the coverage of state-mandated information."* Rewriting this statement in reference to higher education..."*the best goals promote curiosity, questions, and interactions among student learners rather than coverage of course-mandated information.*"

Let's think on a scale larger than courses. Think of knowledge domains with meaningful rather than arbitrary boundaries. Think of electronic information systems and the potential for connections by hypertext and multimedia technology. Why limit students to specific reading assignments when they can search globally for information

resources by clicking a mouse? Why restrict students to assigned readings when electronic searches and hypertext links are readily available? *Wouldn't it be better for them to learn how to search for meaningful background information than to simply look up page numbers?*

The potential for integrated learning in not only great, but also very new. Can we expect students to know how to sort through the vast information resources now at their disposal? Hardly. Can we expect professors to suddenly begin integrating their course material with other professor's course material? Hardly. *Truly integrated learning may be difficult to implement, but that very truth should compel professors to incorporate n-dimensional thinking into higher education learning environments.*

CONCLUDING REMARKS

Knowledge is n-dimensional and interconnected, and n-dimensional learning is interactive. Children need to learn in context in order to apply what they have learned in different circumstances. College students should have more than a list of courses to choose from each semester. Integrating knowledge should not be left up to them after graduation, for that takes a miracle that may never happen for many of them. College professors should do their best to introduce students to knowledge connections and work with students in active problem solving, integrating, and cooperative learning environments. Then, *the miracle may not be necessary because the graduates will have had meaningful experiences as problem-solvers throughout their college career.*

Chapter 6
Knowledge is Powerful

Students are tested so often to see what they do not know that they may have difficulty recognizing the importance of what they do know. *Knowledge is powerful*, and it becomes more powerful as information is accessed more quickly, evaluated faster, and integrated more completely.

The concept of power has a negative connotation as well as a positive one. In the traditional college classroom, power is associated with the professor. In the cooperative learning environment, power should be associated with ***knowing***. A person who ***knows*** how to do something can do it. A person who ***knows*** has information to share with others. A person who ***knows*** can be a producer rather than a consumer.

Teachers are responsible not only for helping students remember facts and understand relationships but also to use technology to process information effectively. As hyperlearning technology advances and technology makes data storage a trivial concern, the *"...measure of human competitiveness in the HL [hyperlearning] world will be not what you remember, but what you can understand"* (Perelman 1992). Recall has traditionally been a high priority in higher education. *Perhaps it is better if students are held responsible for remembering less but understanding more*.

LEARNING LESS BUT KNOWING MORE

Learning less yet knowing more may seem like a paradox, but it is an important concept. We cannot learn all that is available in books and we cannot know how to do all the

calculations that have been made. We must apply specific concepts to problems at hand, using conceptual problem-solving power.

Conceptual Power

An experience I had in 9th grade is an example of how the conceptual approach provides the "power" for any number of answers while a simple answer applies to one situation only.

> *My general science teacher demonstrated the effect of air pressure by placing a rubber diaphragm over the end of a thistle-tube. When a suction pump lowered the air pressure inside the thistle-tube, the rubber stretched into the tube as the air pressure was greater on the outside of the tube than on the inside. In the test that followed, the teacher asked "How far will the rubber go in if the end of the thistle tube is covered with glass and sealed with wax?" He expected "not at all" for an answer. My answer? It would go in until the pressure was equal on both sides of the diaphragm.*

My conceptual answer applied to all situations. Whatever the air pressure is on either side, the rubber would assume a position of balance. The teacher marked my answer wrong based on that one case. My conceptual answer was valid in all cases. *That experience 50 years ago has been an important benchmark in my approach to teaching.*

How do we promote conceptual power when there is so much information available to be learned? Information retrieval is not the challenge. The challenge is to make the higher-level connections among the information in order to

develop insights, promote understanding, create knowledge, and acquire the skills needed to solve problems. As Perelman (1992) states: *"The job of hypermedia alone is to inform; its job as part of the fabric of hyperlearning is to empower."*

Maximizing Problem-Solving Power

How do we maximize problem-solving power in higher education? There is no simple answer to this question, but some factors that contribute to it can be identified.

Identifying basic patterns. There are many basic patterns in the world…social patterns, biological patterns, physical patterns...and *learning more about these basic patterns is one way of maximizing problem-solving power."*

Transferring knowledge from one problem to another. After identifying basic patterns, we can transfer knowledge from one problem to another. Most problems are not new, but are variations of old problems. *That is why it is so important to understand basic concepts and to recognize basic patterns in the world.*

Using the current knowledge of students. Students have current knowledge in many different subjects. This knowledge can be used to promote knowledge integration and seamless, interdisciplinary courses. *Professors and students are, collectively, in a position to integrate knowledge from many subject areas into more complex holistic understanding.*

Using the in-depth knowledge of professors. Professors have more in-depth knowledge in their specialties than their students have. They have more experience and perhaps more wisdom as a result of their greater experience. Professors should be effective facilitators and catalysts in the learning environment, *stepping in with key information at the*

right time, stimulating student thinking, and maximizing their problem-solving power.

Group knowledge. The power of two minds is greater than one of those minds alone. Since college students have current knowledge in several subjects, working on problems in a group setting makes problem-solving more effective. *College students have knowledge and problem-solving skills that should be shared with other students in an interactive, cooperative problem-solving environment.*

Using Decision-Making Power

Since cooperative work involves decision-making by groups rather than supervisors giving orders, decision-making is not just a skill to be learned; it is an essential component of group power. What should students learn about decision-making in a cooperative learning setting? Some ideas follow.

Identifying problem and options. Many problem-solving situations involve two or more options. A group of students will likely identify more options than an individual will. Giving students opportunities to discuss the advantages and disadvantages of different options is an important part of their education. *Expanding horizons by increasing the number of problem-solving options is one of the values of group work.*

Sharing individual feelings. Each student in a learning group should feel that their opinion is important. Professors can nurture this by arranging groups so responsibilities rotate among the students, giving everyone chances to both lead and follow. *If only the most experienced students have leadership opportunities, less experienced students may withdraw even more.*

Respecting others. Respect for the opinions of others and considerations of their ideas contribute positively to the willingness of students to make contributions to group discussions and decisions. *Students should learn from and respect each other rather than put each other down.*

Compromising. Individuals must compromise when working in a group since each student cannot have his/her way. Good feelings about each other make it easier to compromise, while arguments and accusations divide groups and decrease group effectiveness. Discussion and agreement on compromises need to be practiced, and a cooperative learning environment provides many opportunities for negotiation. It may be hard for professors to listen to students work things out amongst themselves when the best decision could be imposed on them. *Professors must be patient; students are learning while negotiating!*

Group Confidence

The success of cooperative learning environments depends on confidence among different groups of people. Confidence does not just happen; it comes from carefully designed strategies that build confidence in an interactive learning environment.

Confidence of professors in themselves. Confident professors are essential in a cooperative learning environment. Giving up center-stage and working <u>with</u> students rather than lecturing at them increases the range of questions that might be asked. Professors who have confidence not only in what they know but also in how they respond when they do not know are comfortable working cooperatively with students. *Confident professors who can deal with uncertainty are good models for students.*

Confidence of students in professors. Confidence of students in professors is essential in a cooperative learning environment. One of the most effective ways for professors to gain the confidence of students is by participating with them in the learning environment. Professors gain the confidence of students by working with them rather than grading them without a chance for them to improve their work. *Learning together is demonstrated rather than dictated in a cooperative learning environment.*

Confidence of professors in students. Professors demonstrate confidence in students by giving them significant responsibilities and learning opportunities. Patience is needed often as students learn how to share what they have learned with others. It is tempting to revert back to an authoritative "do as I say" approach when progress seems slower than expected. *Students respond positively to the confidence professors have in them; recognition of their good work increases their desire to do even better*

Confidence of students in themselves. Students who have confidence in themselves are more likely to learn more than students who are insecure. How can teachers help students become more confident? Some students need smaller assignments in order to be successful while others can handle larger ones. Activities that give individuals positive experiences within groups help increase their confidence. Giving them opportunities to share oral and written work, helping them feel like they are productive members of a learning group, recognizing their contributions with sincere appreciation and reward...*such positive experiences all help students gain confidence in themselves.*

Confidence in learning groups. Confidence in learning groups is enhanced when students discuss, make decisions, meet goals, and produce educational materials of value to others. Group confidence increases when students help each

other understand concepts and solve problems, when the group comes up with answers to questions, and when groups are given responsibility for assessing their own knowledge. *A sense of accomplishment, whether by an individual or a group, always leads to higher levels of confidence*.

Group Productivity

Group productivity is one of the keys to a successful cooperative learning environment. Group productivity depends on the productivity of individuals and subgroups within the larger group. A feeling of mutual responsibility within a group is important; each member of a group should feel responsible for the success of others in the group and the group as a whole. Some major factors that contribute to group success and productivity are discussed below.

Decision-making. Decision-making needs to be shared within a group if everyone is going to feel important. Professors should not tell groups what to do and when to do it; the group should decide such things so there is a feeling of ownership and responsibility by members of the group. Professors should create a learning environment in which students develop social skills and want to participate in decision-making. Group progress may seem slow at times, but a cooperative learning environment is not a dictatorship. *Students should feel like valuable contributing members of a society of learners.*

Preparing information resources. Learning groups become most productive when they not only make decisions affecting the group but also when they prepare tangible products to share with others. While products can be shared orally, it is even more effective when they are shared in writing as well. Learning groups that are <u>writing to learn</u> rather than "learning to write" are expected to have

something of value to share with others when they finish their work. *Meeting that expectation and publishing what they write makes students feel empowered with knowledge.*

Group assessment. Learning groups should learn to assess their own effectiveness and productivity. When students assume responsibility for doing their work as individuals in a group and as a group, they also assume some responsibility for evaluating the quality of their work. *Being able to evaluate the quality of their own work gives students confidence and a feeling of control over their own destiny.*

Student Power Should Continually Increase

A cooperative learning environment, coupled with a publishing system that provides access to student work for years to come, should result in a continual increase in "student power." What kind of student power is being promoted? The power that comes with *knowing*. Knowing how to do something, how to formulate a problem and arrive at a solution...*conceptual power and application power.*

Confidence increases with power. The more students learn, the more confident and powerful they become. Confidence increases not only with knowledge, but with the use of knowledge. *Students feel empowered when others use what they have learned and shared.*

Cooperation increases. Cooperation increases when there are meaningful opportunities to learn from each other. Contributions to the learning environment increase when meaningful opportunities to cooperate are provided. *Such cooperation is expected in most of life's activities.*

Responsibility increases. The levels of responsibility students assume increases when confidence and cooperation increase. When students have more responsibility for their own learning and for the learning of their peers, they feel

more empowered and want to learn more and share more. *Learning more empowers students; is there a limit?*

Limit student power? Should there be limits to student power? Not in the sense of wanting the students to learn "only this much." How should we view student power then? Consider this immediate goal...professors should promote student power to the extent that students rely as much or more on themselves and their peers as they do on their professors for their learning. *The ultimate goal is students who are self-directed life-long learners.*

What if students are so empowered with knowledge that they rely entirely on themselves and their peers, making professors unnecessary? Wonderful! Professors who empower students to that extent have done their job to perfection! *When teachers become unnecessary, the ultimate educational goal has been reached.*

Professorial Power Should Continually Increase

Professorial power should continually increase in a cooperative knowledge-empowering environment because "power" in the sense used here is a multiplying resource. As students assume individual responsibility for their learning and group responsibility for each other's learning, the power of the teacher to promote learning is multiplied.

Multiplying professorial power. Having students work together in a cooperative learning environment reduces the amount of teacher-student contact needed because students help each other. Each student is a teaching assistant responsible for helping other students. *Professorial power multiplies in a cooperative learning environment.*

No barriers to learning. There should be no artificial barriers to learning in a cooperative learning environment. Since information is a resource that does not diminish with

use, knowledge has the potential to continually increase. The only barrier to learning, ideally, should be time. *Professors should never be the limiting factor in their students learning.*

Respect deepens. Professorial power increases when students respect their professors for working closely with them. Deeper contributions to student thinking are possible when working closely with them rather than just lecturing to them and answering their questions. *Mutual respect increases as professors and students combine their mental powers and work together to solve problems.*

Logical and effective organization. Professorial power increases when logical and effective organization is encouraged, when professors guide learning searches, stimulate their students to ask better questions and set up a productive framework for students to work in, learn in, and contribute to others in. *Effective organization of the learning environment promotes meaningfulness in learning.*

Maximize student productivity. Creating a learning environment that motivates students to learn because they want to learn maximizes student productivity. *Publishing the products of their learning in electronic information systems multiplies the value of their work as other students use it.*

Multiplying Professorial Power

Suppose professors accomplish the empowering discussed above. Let's add one more teacher-empowering factor—the power of several professors working together. Let's multiply professorial power by extending cooperative learning to cooperative teaching.

Cooperative teaching, an extension of cooperative learning rather than a new approach to teaching, is justified on the basis of the connectedness of information, concepts,

knowledge, issues, and problems. Teaching subjects and courses in isolation does not make a lot of sense if students are expected to relate what is learned in one subject to other subjects. If teachers do not cooperate in a learning environment that promotes such relationships across subjects, then students must do that on their own. *What kind of miracle is expected of students if professors do not cooperate with each other and relate connected information?*

Cooperative teaching for professors. When several professors cooperate and promote cooperative learning in their courses, their horizons will expand just as student horizons do when working in groups. Cooperative teaching is much more than "team teaching" or taking turns giving lectures, however. Cooperative teaching occurs when several courses are part of a common cooperative learning environment. Cooperative teaching occurs when students in several courses work with several professors on integrating problems. *The courses are seamless, and the subject matter is integrated naturally and automatically.*

Integrating subjects. When several teachers use a cooperative learning approach, integrating subjects is natural. Students share their experiences from other courses and group work is enriched and expanded. Such an approach is described in Moen et al. (1996, 1998). *When an integrated information system is used as the publishing medium, students in any course have access to the material in any subject.*

Seamless courses. Seamless courses represent reality. Behavior and physiology are integrated in biological organisms. Business and law are integrated in society. Economics and resource management cannot be separated. Literature and art go together. Seamless courses give students opportunities to work together on questions that are

connected across course lines, accessing whatever information and relationships are appropriate for the problem at hand. In a truly seamless course environment, students enroll in different courses while working together in learning groups in a cooperative learning environment (see Moen et al. 1998 and Chapter 9 in this book). *This unique approach represents a new paradigm in college teaching.*

When several teachers cooperate, when courses are seamless and subjects are integrated...students do not have to shift gears between classes and between semesters. Students move right into new subject matter without having to adjust to different learning environments, and they can focus on integrating knowledge into more meaningful wholes rather than separating knowledge into smaller pieces that, by themselves, are less meaningful.

CONCLUDING REMARKS

When students are given the opportunity to make decisions and work together, the learning opportunities increase dramatically. Not only does this provide important experiences for students in "real-life" situations where it is important for all to work together, it also gives students the opportunity to contribute more directly to their own education. *When students and professors all work together to acquire knowledge, make decisions, and solve problems, everyone is empowered with knowledge, and knowledge is powerful.*

Chapter 7
Sharing Knowledge by Publishing

Learning is the product of education, and this product should be shared among students and faculty. Students are just a few years, months, or even days away from having a job in which they will be required to share what they know and do with others. Professors already have such a job, not only as teachers but also as authors and researchers who publish the results of their work in books and journals.

Knowledge is empowering, and its power can be shared by publishing. Professors in many colleges and universities are not only expected to publish, they are compelled to publish or they will not be tenured. While the appropriateness of the "publish or perish" approach is often debated, it does compel professors to share their knowledge and the results of their research with other professionals.

Think of college students as embryonic professionals acquiring the knowledge and skills to do what professionals do—acquire new knowledge and share that knowledge and their skills with others. When should the professional learning process begin? At graduation? The first day on the job? After a period of apprenticeship? *It should start in the first college course and continue through the four years of undergraduate education (Moen et al. 2000).*

FROM TERM PAPERS TO PUBLISHED AUTHORS

While knowledge can be shared in different ways, publishing student work electronically motivates the students greatly. With computers and networks now being the norm, student publishing can be done easily on a local area network.

With the availability of hypertext software in 1991, I made the decision to require my students to write a computer-based file that could become part of an electronic information system in a local area network rather than writing the traditional term paper. I wanted the students to share their writings with each other rather than have them write another term paper to be graded and discarded. The students did not object to the idea, but four seniors stood before my desk crying real tears because they had to use a word processor rather than a typewriter! One had spent all evening in the library just trying to figure out how the word processing software worked, and hadn't accomplished a thing. That was just over 10 years ago. Now, the students would be crying if they were required to use a typewriter!

Since current students use word processing routinely and will be using electronic information processing during their careers in ways we can't even imagine now, it is very important students to learn how to share their knowledge. In this chapter I will share my experiences with student publishing and student editors with the hope that it will make it easier for professors to begin using this powerful motivator of higher quality writing by undergraduates.

Writing to Convey Information

How many term papers are written each year by capable and sincere students in colleges and universities across the country, only to have the term papers graded and discarded? If some of these are not of high enough quality to warrant publishing, what kind of miracle is expected of the student when they have to write their first report on the job? What can be done to help students improve the quality of their writing to make it worth publishing? Should they be sent off

to another writing class? Isn't it better to have professors in all subjects help their students bring their writing up to publishable quality while enrolled in their courses?

When students are given the responsibility to write to convey information to other students rather than just submitting a term paper to be graded, the meaningfulness of a writing assignment increases immediately. Since most students do not want to share poor writing with their peers, writing quality is enhanced simply by making term papers available to all students, which can be easily done in electronic information systems. What considerations should one make when implementing a system of student publishing? Begin with the premise that a*uthors are made, not born.*

Authors are made, not born

While writing is an essential skill learned early in life, authors of different kinds of publications learn how to write according to styles suitable for the content and the publishing outlet. Giving students opportunities to be published authors, even if it is in an information system confined to a local area network, makes students feel good about their writing because they know others will read it. Students want to be better authors when they know their work will "live on" after they finish the course. *The pride I observed in my students when they saw another student learning from one of their publications in our information system was very obvious.*

Writing improves with regular practice and helpful editing. Editing help should come early in the writing effort, not at the end. Grading term papers at the end of a course, even if helpful editorial comments are included, does not help students improve their writing while they are in the

course. Helping students write better by editing just a page or two of their first draft provides an early opportunity for providing editorial advice.

Authorship and ownership considerations

Student publishing raises several authorship and ownership considerations. Students may author their publications alone, with a co-author, or as a group. Student authors have ownership over what they have written, and there is much for them to learn about author contributions, proper credit, citations, and the potential for plagiarizing.

Authorship is based on contributions. Student authors should learn that authorship should be based on the contributions of each author to the publication, similar to publishing in professional journals where a senior author is assumed to be the major contributor. With electronic information systems, students can improve on publications of previous students while learning to recognize the contributions of different authors and arrange authorship accordingly. Students who makes slight editorial changes to earlier publications should just be acknowledged, minor contributions could be recognized by being listed as a junior author, and major contributions should result in a senior authorship. Judging the relative contributions of each author is a good experience for students. *Improving existing files is a legitimate publishing procedure; we call such improvements second, third and fourth editions of books.*

Ownership and copyright considerations. Ownership of written materials indicates the "source" of information and may or may not mean protection. Students that publish, even on local area networks, must learn the meaning of ownership and copyright. They need to learn that it is illegal and unethical to copy the work of others and claim it as their

own. Authoring opportunities give students the chance to make real judgments on what is appropriate and what is not regarding ownership, quotations, giving credit to others, and proper citations. *Student authors learn the real meaning of ownership when they share their work with others rather than protecting it from others.*

USING WRITING TEMPLATES

Students have usually been given guidelines to follow when writing the traditional term papers. While professors want students to write creatively, guidelines provide a framework within which creativity is to be expressed. Professional journals distribute guidelines to be followed. When students publish their work on a local information system, guidelines are needed to provide consistency in format and style.

A typical format for scientific publications that could be followed by students publishing electronically contains the headings shown below. They can be modified according to the protocol used in journals in different subject areas.

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- *Title & Author(s)*
- *Abstract (a clear paragraph describing what was learned)*
- *Introduction (to the research conducted)*
- *Literature Review (of pertinent published literature)*
- *Methods (describing exactly what was done)*
- *Results (in table and graph form)*
- *Discussion (of the results and their implications)*
- *Summary (of the entire publication)*
- *Literature Cited (complete citations to all references)*

A ***Written and Oral Communications System*** was prepared for the student authors in our Cooperative Learning

Center (see the Preface). This system contained many different templates for the students to download when writing different kinds of publications for our local area network. Templates provided each student with the basic structure of a publication with headings that could be appropriate.

The introductory file in the ***Written and Oral Communications System*** contained a description of each of the templates, and students could download the desired template from this introductory file. They could also print the introductory file and every file in the entire Information System, if they wanted hard copies. *Note that printing by the students when they needed hard copy replaced the usual distribution of handouts in class.* The menu contained the following writing templates:

- Written Communication Guidelines
  - Writing a Resume
  - Writing a Cover Letter
  - Writing a Letter of Application
  - Writing a Letter of Appreciation
  - Writing Job Announcements and Descriptions
  - Writing Review Papers
  - Writing Research Plans
  - Writing Research Objectives
  - Writing Research Proposals
  - Writing Progress and Final Reports
  - Writing Executive Summaries
  - Writing Scientific Papers
  - Writing Briefing Papers
  - Writing Book Reviews
  - Writing Decision-making Recommendations
  - Writing News Releases

The templates not only relieved each student of the need to recreate the appropriate structure each time they prepared

a particular kind of publication, but it also made peer editing, discussed next, much easier. Similar guidelines were provided for oral communications.

PEER EDITING

When students become excited about being "published" authors, they want to write more than if they are limited to traditional term paper assignments. Professors may not be able to keep up with reading all that the students want to write, nor should they be expected to. A publishing protocol can be developed that distributes responsibility for editing among student authors, just as professionals do in professional journals.

Student editorial boards

A major part of the responsibility for editing files to be published electronically can be assumed by a student editorial board. The editorial board in the Cooperative Learning Center was composed primarily of undergraduate teaching assistants (see Chapter 8). The student editors learned not only about the editing process, but also about evaluating the contents of manuscripts and the psychology of authorship.

Peer editing was a very good learning experience for students. They became more critical of their own writing after editing the writing of others. Peer editing gave students a greater sense of ownership in the information system. It was obvious that students have more pride in student-authored and student-edited publications than in term papers that have simply been graded by the professor.

Having student editors encourages new student authors because they will recognize that students have meaningful roles in the publication process, and in a cooperative learning environment, students expect help from other students. Knowing that student editors have published in the information system gives them credibility as editors in the eyes of new student authors.

Having a system of peer review and groups of student editors places responsibility for good writing on the authors—the students themselves—where it belongs. Providing opportunities for students to publish their work enlarges the potential usefulness of their writing at almost no cost, especially on a local area network.

Editors, both students and professors, should give meaningful constructive criticism while being sensitive to the author's feelings. Writing is a very personal thing, and submitting what an author feels is good writing only to have it torn apart by editors can be very disheartening, whether the authors are students writing for a local area network or professors writing for a professional journal.

Quantifying student improvement

Student editors can help faculty greatly by reducing the number of editorial comments that might be needed in successive drafts of manuscripts submitted for publication. The number of comments by myself and my student editors on 6 successive drafts of student papers were counted in 1997; the total number of comments dropped from an average of almost 70 on the first draft to about half that number on the second draft. By the 6^{th} and final draft, the average was only about 5 comments and they were primarily copy-editing comments (see Moen et al. 1998).

The first drafts averaged about 50 copy-editing comments, 12 style comments, and 6 content comments. This indicated how little attention students were giving to the style and format of their writing when it was subjected to publishing standards. This can be attributed to a lack of conditioning as students, up to this time, had been writing term papers without having to make corrections until professional-level publication standards had been met.

We also learned from quantifying the editorial comments that while student editors identified many errors, professional-level editing by the Editor-in-Chief (Professor Moen in this case; that's me!) identified several errors that student editors had overlooked. Even though I found a number of copy-editing errors after students had edited two or more drafts, the edited drafts were much better than the first draft of a typical term paper. Further, student editors improved with experience.

EDITING PROTOCOL

Student editing is not accomplished by simply asking students to serve as editors. They must learn a professional protocol and receive editorial guidelines, just as professionals do when receiving a manuscript to be edited for a journal.

Clarify mechanics first

The templates discussed earlier in this chapter relieved student authors of the responsibility for designing their own publications. While students had no excuse for not submitting publications in the proper form because they had access to the guidelines and every publication in the information system was a model for them to follow, most of

them had not been exposed to this level of discipline in their writing before. They quickly learned that their manuscript would not be accepted for the first editing unless it was formatted properly, just as professors learn to follow journal guidelines when submitting manuscripts for publication.

Encouraging student authors

Students who are expected to publish need more help and guidance when writing their papers than is the case when they just write a term paper to be submitted for a grade. Professors should work with the students early in the writing process, editing the introduction with the student and explaining why some sentences are good, some are vague, some are wordy, some are excellent…and encouraging the student to be more critical of their own writing as they continue. It is so important for students to learn to edit as they write, minimizing later editing by student editors and the professor. Some additional thoughts about editing as students prepare publications to be shared with others follow.

Commendations. Student authors are encouraged by positive comments on good writing. Every manuscript will likely have some good writing in it and should be highlighted before suggestions for improvement are made. *Commending young authors first and then offering suggestions for improvement is the acceptable procedure.*

Suggestions for improvement. Suggestions made by student editors for improvements in both content and style will likely be well received by student authors, especially after some good points about their writing have been made. Student editors should also realize that when content is beyond their scope of knowledge, they should enlist the help of other student editors or professors. Student editors should

also realize that suggestions for improvements should be made only until changes make the writing better. *If suggestions make the writing different but not better, it is time to stop editing.*

Quality expectations. High quality writing must be expected of student authors if their publications are to be a valuable resource for other students. Writing less but writing better is a good guideline to follow. Isn't it reasonable to expect students to author professional quality publications? If not, then we are saying that the writing of graduating seniors will be less than professional when they take their first job, unless a miracle happens and they suddenly become professional writers upon receiving the degree. Yes, it is reasonable to expect students to author professional quality publications, but they need the help of others, both students and teachers, in order to do so. *Professors with many years of experience benefit from the editorial comments of their peers when they submit manuscripts for publication in professional journals; the same opportunity should be made available to students.*

INFORMATION SYSTEM PUBLISHING

Electronic student publishing needs to be organized well, easily accessed, and flexible so that articles may be edited, added to, and in some cases, deleted. Student publishing would not be feasible to any great extent were it not for electronic Information System Publishing. It is so much more flexible than publishing printed copy.

Sharing knowledge and ideas efficiently, which means electronically, should increase the potential for learning because students are no longer slowed by mechanical access to printed information in books and journals. Further, publications can be dynamic; calculations, for example, can

not only be described but also downloaded for students to use. Links to related information can be inserted. The potential is almost endless.

What kind of work can be published electronically? Several different kinds of files representing a variety of creative opportunities for sharing information and knowledge can be included in an electronic information system.

Text files

Text files are the basic building blocks in an integrated electronic information system. The text file should have a title that clearly indicates the content, and key words can provide additional information about the content. Links provide access to related information, and searches provide lists of other files that contain related information.

Readers in an electronic information system can access definitions when they need them with hypertext links, just as we do when using electronic dictionaries in our word processing. When student authors identify new words and key words in their writing and establish links to definitions for the benefit of the readers, the authors become more conscious of the material they are writing about and the new ideas they are sharing with other students.

Supporting files

Text files can also include a variety of other files that enhance the word-based explanations and provide more interaction between the reader and the material in the text file. Some examples are described next.

Image and video files. Electronic information systems can include images and video clips that compliment text

material. For example, a description of the taxonomic characteristics of a flower is enhanced by an image of the flower. In addition to reading an excerpt from a speech, a link to a video and audio clip of the speaker provides a powerful supplement to the written word. Links to images and video clips provide supplementary information when it is needed, which is the most meaningful time for students to access it.

Calculations and graphs. Readers can link to calculations and graphs in electronic information systems, not only to complete complex calculations but also to visualize the results. This is especially meaningful when students enter different values and see the effects that variability in different parameters have on the relationships being studied.

Quizzes and tests. Electronic information systems can include quizzes and tests for students to access whenever they want, or as part of formal testing procedures in a course. Quizzes can be useful pretests, and as indicators of comprehension as students learn new material. Built-in scoring and grading, options for retrieving correct answers to questions that have been missed, and calculations of letter grades can be part of electronic testing systems.

References. Additional references in a subject area, as well as literature cited in a file, can be made available by links in an electronic information system. Electronic access to library resources is now routine; "going to the library" is becoming an electronic event rather than a physical one.

Other Communications

Students benefit from preparing a variety of communications to be shared with others, improving their communication

skills and gaining recognition for their work. While writing courses are commonly required of college students, there are relatively few opportunities for students in traditional text-lecture-test courses to continually improve writing skills. Many other kinds of communications can be incorporated into an information system. Professional-quality newsletters, for example, can be easily prepared with word processing and distributed in printed and electronic form. Students enjoy writing news releases and distributing them electronically to others in their learning environment. All of the written communications for which templates listed earlier in this chapter could be published on a local information system.

Information system menus

Accessing the files in an information system should be easy, logical, and intuitive. Web sites, which are information systems, have a variety of front-end designs. Some are simple and load quickly; others are more complex and load more slowly. Since web site design is not within the purview of this book, an example of a simple menu approach is given here to provide a starting point.

Menus can be arranged in many different ways, and there can be more than one menu organization for an information system. In the Cooperative Learning Center that is described in Chapter 8 and for the course continuum described in Chapter 9, menus provided access to courses, species and subject areas. Abbreviated examples are given below.

Course-related menus. I wrote, with the assistance of my graduate students, concept files for each of the courses in

the continuum that is described in Chapter 9. The course-related menu contained the following main entries:

- NR 104: Natural history information management concepts
- NR 105: Natural history information management applications

- NR 204: Natural Resource Modeling Concepts
- NR 205: Natural Resource Modeling Applications

- NR 304: Wildlife Ecology Concepts
- NR 305: Wildlife Ecology Applications

- NR 404: Wildlife Population Concepts
- NR 405: Wildlife Population Applications

- NR 410: Wildlife Management Concepts and Applications

- NR 498: Teaching in Natural Resources

Species-related menus. Species-related menus provided students with access to the files that pertained to a particular species. Note in the sample menu below that main headings are proper taxonomic terms, biological functions are listed first followed by the species, and titles are consistent for different species. *A logical system of file names helps greatly in the organization of an information system.*

- *Odocoileus virginianus* (white-tailed deer)
  - Body composition, white-tailed deer (*O. virginianus*)
  - Body temperature rhythms, white-tailed deer (*O. virginianus*)
  - Food habits, white-tailed deer (*O. virginianus*)
  - Weight rhythms, white-tailed deer (*O. virginianus*)
- *Alces alces* (moose)
  - Body composition, moose (*A. alces*)
  - Body temperature rhythms, moose (*A. Alces*)…etc.

Subject-related menus. Subject-related menus listed typical subject areas but not specific courses. They identified files in the network that pertained to the subject

area. An abbreviated subject-related menu is shown on the next page.

- Anatomy and morphology (files names would follow)
- Behavioral ecology
- Natural History
- Nutritional ecology
- Physiological ecology (sample file names are given here)
  - The concept of biological time
  - Baseline metabolism
  - Body temperature rhythms, white-tailed deer
  - Chemical composition of milk, white-tailed deer
  - Chemical composition of milk, moose
  - Physiological thermoregulation
    - The concept of homeothermy
    - The thermal energy environment
      - The critical thermal environment concept
      - …and any number of files could be added

The examples above illustrate how the same files may be accessed from different menus. Search functions and links can also be used to find files with related information. Only the imagination and skill of the designer limit the design of the front end of an information system. *Students can be a great help to professors when designing an information system for an integrated learning environment.*

CONCLUDING REMARKS

If both students and teachers are empowered with knowledge, that knowledge should be shared not only with other students in a course but with students in other departments, colleges, the university, and even the rest of the world. Electronic information system publishing provides students with unprecedented opportunities to share their valuable work with other students, *and student publishing*

was the best motivator of good writing that I observed in 40 years of teaching!

Chapter 8
Cooperative Learning

Cooperative learning is a new idea to professors who think of higher education as lectures, laboratories, term papers and competitive exams. Evaluating the roles of individual, competitive and cooperative learning in the classroom, Johnson and Johnson (1994) state *"Cooperation is the most powerful of the three ways to structure learning situations."* While college students often meet in discussion groups and work together in pairs in laboratories, formal cooperative learning is more than just having students work together. Cooperative learning focuses on group work where professors are guides more often than lecturers. Our approach to cooperative learning prior to my retirement from Cornell in 1998 are in Boomer and Moen (1996), Fazzari and Moen (1996), Moen and Decker (1996), Runge and Moen (1996), Moen et al. (1996), Moen et al. (1998), and Moen et al. (2000); some of the details are summarized in this chapter.

The concept of cooperative learning has been discussed for many years (Slavin 1983) and was active in public education during the late 1800's (Johnson et al. 1984). Because students teach themselves and their peers they retain information more effectively than when they learn passively by themselves (Davis 1993, Ventimiglia 1995). By working with their peers rather than competing against them, students learn to communicate, compromise, and produce as a team.

The room in which cooperative learning takes place may not look much different from other college classrooms or laboratories; it is how learning takes place that is different.

A COOPERATIVE LEARNING ENVIRONMENT

Lecturing is so traditional in college that many professors may find it difficult to move toward a cooperative learning environment. College students may have a hard time adjusting too because they expect to go to lectures, take notes, read text and reserve reading assignments, write term papers, and take tests. Both professors and students may resist a cooperative learning approach just because it is different.

Giving lectures may seem to be more efficient than implementing interactions among students during lecture periods, and it is if delivering information is the goal. While it is not my intent to minimize the value of a stimulating lecture, our goal as educators should be to maximize learning. College classrooms, however, are often designed for high faculty:student ratios that maximize information delivery. *If maximizing learning is the goal, then professors should try to develop the most effective learning environment possible.*

Physical Design

A well-designed cooperative learning classroom promotes communication and cooperation among students so learning occurs naturally. The arrangement of the room should encourage discussion, and information resources and research equipment should be readily available so students can work together efficiently. As Johnson et al. (1984) point out, the physical arrangement of a room or rooms is an

important determinant of how, and how much, students learn.

Furniture. Students should be able to work in small groups at small tables, and meet as a larger group at larger tables. Chairs should be placed around the tables with no "head" chair for the professor because students work with, rather than just listen to, the professor. Computers should be an integral part of the room; they should never be in a separate "computer room" because they are used so often throughout the learning process. TV/VCR units should be available for individuals and small groups to view course-related videos. The traditional blackboard should also be available for students to use when sharing and discussing ideas. Ideally, a cooperative learning environment should include a room or group of adjacent rooms where a variety of activities—formal and informal, small group and large group—can take place.

Research equipment. College courses usually include some kind of independent library, laboratory, or field research. Laboratory and field research involves special equipment that should not only be readily available to the students, but instructions for its use should be published electronically on the local area network. Manufacturer instructions can be supplemented by material written by students who have used the equipment, helping students learn to use the equipment more quickly. Keep in mind that students in a cooperative learning environment design their own experiments rather than all doing the same one at the same time.

References. References needed to prepare background information and document current work by students should be readily available either physically or electronically from the cooperative learning area. A collection of particularly

important reference books should be available in a library corner and the in-room computers make it possible for students to access library resources. If a work group needs to go the library to access references, a cooperative learning environment provides that flexibility.

All of these ideas, and many more not mentioned, will likely not be possible to include or implement immediately when moving to cooperative learning in college courses. Suggestions for making the transition are in Chapter 11, and as cooperative learning becomes more important in college courses, rooms will, hopefully, be designed to accommodate this dynamic approach better.

Group Design

Cooperative learning focuses on learning groups that vary in size from two to the whole class. A small working group of 3-5 students is one of the more common group sizes. Each individual in the group is responsible for part of the group work, and the group is responsible to the whole class.

Small working groups. A small group of 3-5 students can work on a specific concept, experiment, publication or presentation and share their results with the class. Such a group should have a leader, and students should take turns being the leader if they work together for a longer period of time. Working groups should change periodically, and the individuals should be identified objectively rather than by students choosing their own partners. Each learning group is to be responsible for some identifiable learning experience, and each individual in the group is responsible for contributing to the group.

Individual responsibilities. Individual students are responsible for their own reading, writing, and contributing to the groups ideas. Individuals take turns being leaders. Sometimes they may be given specific roles, such as chairperson, recorder, and even "encourager." The chairperson leads the group, the recorder takes notes on work being done, and an encourager commends the others for their contributions. *The role of an encourager can be very effective because students want to do better when others recognize their work and commend them for it.*

The class as a whole. All of the students learn from each other in a cooperative learning environment. The publications of individuals and small groups should provide substantial information to the entire class. Large group discussions and class conferences provide opportunities for students to share formally what they have learned with the whole class.

The role of an Oral Communication System

Students should be encouraged to make professional-quality oral presentations in a cooperative learning environment. It cannot be assumed that students know how to do that…instructions for a variety of oral presentations were part of the ***Oral and Written Communication System*** in our Cooperative Learning Center, accessed through the menu below.

- Oral Communication Guidelines
  - Introducing Ourselves and Others
  - Interview Guidelines
    - Job Interviews
    - Information Interviews
  - Performance Reviews
  - Speech-making Guidelines

- Presenting Scientific Papers
- Meeting Preparation Guidelines
  - Preparing Meeting Agendas
  - Chairing a Meeting
  - The Business Lunch
  - Telephone Conference Calls
  - Radio Presentations
  - Video and TV Productions

Students in the management class (see the course list on page 97) participated in almost all of the above oral activities. They conducted information interviews with other professors, sometimes while having a business lunch, prepared agendas and chaired meetings, introduced speakers, arranged for telephone conference calls, and more. All of these activities were real; they were not practice sessions where another student pretended to be a special speaker…students introduced real guest speakers for the class.

The Roles of the Professor

College professors are not likely to be able to make sudden and wholesale shifts from traditional to cooperative learning. Many elements of cooperative learning can be incorporated in the more traditional classroom and course structure, however. Some ideas are shared below.

The lecture period. A subtle shift in emphasis can be made by thinking of the lecture period as a time when a variety of learning activities, including one or more short lectures, replace the traditional 50-minute lecture. Delivering large amounts of information by lecture is no longer necessary because information can be made readily available electronically. Short lectures of 10-15 minutes duration can be interspersed with temporary discussion groups of a few minutes duration. They can be set up in almost any

classroom for discussion of an idea, concept, or question presented by the professor. Group size is determined in part by the arrangement of seating, but three students in a group is a good size.

The professor as guide. The professor is much more of a guide who works with the students than the one who is the source of knowledge for the students. Rather than being the authority who is responsible for what the students learn, the professor becomes a facilitator who helps students identify what they should learn and helps the students become responsible for their own learning.

Authentic assessments. Professors traditionally write and administer examinations periodically throughout a semester. This tends to make the professor-student relationship an antagonistic one because the students are assigned grades relative to their performance on the professor-mandated test. Authentic assessments can replace the more arbitrary tests in a cooperative learning environment as students are evaluated on the basis of their participation, productivity, and publications. Such evaluations are similar to on-the-job assessments that look at the overall performance of a person rather than their responses to specific questions.

The Roles of Students

Students actively participate in their own learning in a cooperative learning environment. While they work with other students much of the time, they must complete their own individual learning activities as well.

Individual learning activities. In the traditional college course, individuals are usually expected to do their own work and write their own papers; they are not encouraged to

work together. In a cooperative learning environment, individuals are expected not only to learn on their own but also to share what they learn with other students. Specific learning requirements are divided up among the students rather than imposed on all of the students at one time. Students then use what they learn to be each other's teachers.

Cooperative learning activities. College students are often expected to do research projects, often alone. Having two or three students work together on original research increases the number of ideas, provides practice in group planning, and may increase the scope of a project and the amount of data that can be collected. Promoting discussions in the planning, data collection, interpretation, and reporting phases of research provides meaningful practice for professional work. Discouraging cooperative research denies students opportunities to work in the way career professionals usually do...*cooperatively with other professionals.*

Competitive learning activities. Competitive learning has a place in cooperative learning environments because every student should be held accountable for the quality of their work. The competitive component may not have to be imposed by professors, however, because peer pressure is a powerful motivator. When students know other students will use their work, competitive motivation happens naturally. *A cooperative learning environment should have an appropriate balance between individual, cooperative, and competitive learning activities.*

Mentoring. It is customary to have laboratory assistants who are responsible for "running the labs" and helping the students with their assignments. Undergraduate students who work ahead of the rest of the other students can be mentors, helping others students acquire the knowledge and skills needed. Students often enjoy learning from a peer more than

from an authority figure, and *a mentoring environment reduces dependence on a laboratory assistant or professor.*

The Roles of Undergraduate Teaching Assistants

Undergraduate student teaching assistants are a valuable and potentially large human resource in a cooperative learning environment (Moen et al. 2000). Professors can identify a group of excellent undergraduate assistants by recognizing the good work their students do, showing respect for their abilities by providing them with meaningful responsibilities, valuing their opinions and perspectives, and by using their academic contributions in meaningful ways with other students. Students look forward to being teaching assistants when meaningful opportunities are provided.

Undergraduate teaching assistants in the Cooperative Learning Center were models for the other students to follow. They had been selected because of their interest and commitment to the cooperative learning environment. They guided learning groups as they prepared plans, helped students design their field research and analyze their data, helped student project leaders prepare for meetings of the learning groups, wrote computer programs, and much more.

The undergraduate teaching assistants met weekly to discuss issues related to the learning environment, to discuss how particular problems might be handled, and to prepare for future activities in the Learning Center. The teaching assistants felt they were an integral part of the learning environment because their ideas and evaluations of the learning environment were respected and implemented.

Some particularly important activities and responsibilities of the group of undergraduate teaching assistants in the Cooperative Learning Center are described briefly on the next page.

- *A wilderness canoe trip to Algonquin Park during the fall break provided an opportunity for the students to enjoy time together and "bond" as a group.*
- *The weekly meetings provided me with an opportunity to share the cooperative learning philosophy and implement specific ideas that strengthened that philosophy.*
- *The students chose different responsibilities in the Learning Center, such as computer operation, library organization, maintain the reprint collection, etc.*
- *Two students signed up for one or two afternoons each week as the TA in charge of the Learning Center, although any TA could assist any time they were able to.*
- *Some of the student teaching assistants were able to help students write computer models, and assisted them with formatting, programming logic, etc.*
- *All of the teaching assistants learned how to edit text files with the student authors before the file was submitted to the "editor-in-chief," that is to me, the professor!*

Many more activities and responsibilities could be added to the above. The best way to summarize the roles of undergraduate teaching assistants is by describing them as professional support staff with responsibilities similar to those of the professor and graduate teaching assistants. At Cornell, the undergraduate teaching assistants enrolled for credit rather than being paid in dollars.

One of the most striking outcomes of this unusual reliance on undergraduate teaching assistants was the high respect the students showed for the undergraduate teaching assistants. I observed senior students enrolled in a course working with a junior teaching assistant as if the TA was a professor!

It must be emphasized that the group of undergraduate teaching assistants learned how to be helpful teaching assistants just as students must learn how to cooperate in a cooperative learning environment. They learned how to gain the respect of the students. When they had questions about how to handle particular situations or students, I would discuss them privately or with the whole group at our next weekly meeting. *Being an effective undergraduate teaching assistant involved a lot of learned behavior.*

BENEFITS OF COOPERATIVE LEARNING

Many students do better when governing their own learning in a cooperative learning environment than when being told what to do. Improvements are not automatic just by turning responsibility over to them, however. Master teachers who motivate students to want to learn and help them learn how to learn very likely have a well-designed framework behind the learning environment that is invisible to the students.

We all need skills to be successful learners, and after over 40 years as an educator I was still learning new learning skills. Information access and problem-solving power have never been greater than they are now because of the personal computer. Learning opportunities never before dreamed of are now available, and it is vital that professors take a long hard look at how they can be used creatively in the classroom. *Avoid doing the same things quicker and slicker*

on a computer; make the learning environment more creative and learning more meaningful instead.

A cooperative learning center provides opportunities to blend a number of different activities together, not only within a course but also between courses. An important concept in cooperative learning, especially with the course continuum discussed in Chapter 9, is that students from several courses work together in a cooperative learning environment at the same time.

Since cooperative learning involves planning by students, they gain practice in time management. By sharing what they learn, they participate in lateral information transfer. These two attributes of cooperative learning are discussed next.

Time Management

Time is a precious and limited resource. When a professor tells the students what to do and when to do it, the professor has assumed responsibility for time management. This is an expeditious way to run a course, but courses should be designed to enhance learning rather than efficiency in teaching. Helping students learn how to manage time by giving them more responsibility for decisions about their progress and productivity during a semester is an important part of the learning experience. Knowing how to manage time effectively contributes to success in both personal and professional life, and professors should give their students opportunities for time management whenever possible. Some considerations when helping students learn to manage their own time follow.

Avoiding over-commitment. One of the ways professors can help their students learn good time management is by avoiding over-commitment. Teachers need not "cover the

material" just to get through it, and they need not burden students with assignments in order to prove it's a "tough course." It is better to think of quality time with students who learn their lessons well because they want to than to over-commit them. *Being a good time management model helps students learn to manage their own time better.*

Setting due dates. It is customary for teachers to set due dates for assignments. Setting one date for all students is an easy way to keep the course calendar simple, but having all the students turn in their assignments at one time creates a workload that often results in long delays in returning their work. Having students set the due dates for their work, within a reasonable time frame of course, puts the responsibility for time management on the student. Further, it spreads the dates out, giving teachers and assistants more time to go over the work with each student and to return it to them sooner. This should result in higher quality work that is worth sharing with other students. *The long-term benefits of closer attention to quality student work are real.*

Lateral Information Transfer

Another benefit from cooperative learning is that lateral transfer of information is maximized. In other words, students in a cooperative learning environment learn from each other rather than waiting to learn from the teacher. A cooperative learning environment is like a one-room school where learning takes place across several grades.

Cooperative work on assignments. It is traditional to have students do their own work, yet it can be very valuable for them to work together on assignments. The "do your own work" tradition is perpetuated in part because teachers feel they must evaluate students individually. While grades are assigned to individuals, the work of individual students

in a cooperative setting can still be evaluated. In fact, individual evaluation is often easier in a cooperative setting because those who work well with others are easily recognized. *It is a more authentic real-life assessment because working together is expected in our society.*

Seamless courses. Having students from several courses working together in a cooperative learning environment promotes the concept of "seamless" courses. Students learn from each other just by working together, whatever course they are enrolled in. Meaningful connections between course contents are made spontaneously in a seamless course environment, which is better than trying to force interdisciplinary coursework. Watching first-year students work alongside Ph.D. candidates in a seamless course environment was rewarding for me when I observed less experienced undergraduates benefit from the help they receive from my more experienced graduate students.

COMPETITION AND CONFLICT

Making a limited number of "A" grades available in traditional college courses guarantees competition. How is the number of "A" grades determined? Usually by decision of the professor. If a course is meant to be tough fewer A's are given. If a professor wants to make a course easier, more are given. However the number is determined, professors can establish arbitrary quantities of student grades.

One of the characteristics of professional work is that workers need to cooperate with each other. They ought to share appropriately, encourage when necessary, and contribute jointly to the success of work groups. Students should be introduced to this need for cooperation when they are preparing for their careers. Cooperation is not automatic in college classrooms when students begin working together

on projects designed to emulate professional work, however, and conflicts arise often. Some experiences with conflict resolution are described next.

Competition may be Good or Bad

In a cooperative learning environment, competition can be good or bad, depending on the context. If there is too much competition in a cooperative learning environment, the benefits of effective cooperation may be set aside as students are reluctant to help the competition, *i.e.* each other. If there is too little competition, students may not be motivated to learn as much. An appropriate amount of competition helps motivate students, and the best form of competition in a cooperative learning environment is peer pressure. Students should want to do well so they do not let their peers down. They may try to outdo each other, even though the ultimate goal is group productivity. Conflicts are sure to arise when groups of students work together, especially when the cooperative approach is new and they have not yet benefited from the effects of cooperative learning.

Resolving Personality Conflicts

Two students told me, independently, that they could not get along with the other. Since I did not expect either of them to tell each other that they had talked with me about their problem, I asked each of them to concentrate on being more courteous, polite, and complimentary to the other. Then I arranged for them to work together on a project. I did not observe open conflict between them as they worked, but neither did I pry into their feelings to see if my suggestions and arrangement worked. I was willing to accept the fact that the benefits of my experiment might not be realized by

either or both of them for some time. Asking them to evaluate the arrangement too soon may have led them to conclude it was a failure. I waited to see if it worked, and in a meeting of seniors discussing their experiences in the Cooperative Learning Center, one of the two commented on the valuable lesson learned when she realized she had a bad attitude toward someone she was working with. The positive approach was more effective than giving each one of them a little talking to about "getting along with others."

Resolving Professional Conflicts

Conflicts between professionals occur regularly in the workplace. When students work together in cooperative learning environments, they not only function more as professionals than students do in traditional learning environments, but the potential for professional-type conflicts is also there. *Learning how to deal with professional conflicts is an important part of career preparation.*

A case of hurt feelings. Nine seniors in my management class were working together on a project that required individual contributions, small group contributions, and whole-group discussions. During common time one day, one student was quite critical of another student. A third student came to the defense of the second student. The first student quickly left at the end of the class period, although he and the third student had arranged to have lunch together after class. Several of the students stopped in my office during the day to talk with me about the group dynamics that morning. They saw something unique during that period—open conflict—that they had not seen before in four years as undergraduates. They also knew that such dynamics can

easily happen in the workplace, and they told me they learned a lot that day. What did I learn?

What professors learn from student conflicts. It was interesting to watch group dynamics when conflicts develop, and there is a delicate point where intervention is needed. It is generally better to let students work differences out on their own, but mediation may be needed. I learned, from the experience described above, how much students appreciated seeing the conflict, although they did not like the conflict itself. Even those who were part of it appreciated it afterwards because they knew it was a learning experience for all rather than a career-threatening professional mistake by each of them. Opportunities like this do not come up in traditional lecture settings where one-way information delivery is the primary form of communication. "*Better to learn from it now than to learn it the hard way when on the job,"* one of them said.

Skill-building by design. I learned from the experiences described above that college students need to learn, with deliberate planning on my part, how to interact with each other when there is criticism of a coworker in a cooperative learning environment. As we reflected on the experiences in that course, we agreed at the end of the semester that we all learned some powerful life-long lessons. We learned that interactions among the students could become more important than subject matter! Conflicts can overshadow the reason for taking a course, or the professional work that needs to be done. *One of the most important points to remember is that proper responses to criticism and problem solving are learned behaviors.*

The professor has the ultimate responsibility. Ideally, students will work out their differences among themselves. Further, it is idealistic to think that every student will react positively and responsibly to all aspects of a cooperative

learning environment. That will not be case. For example, a graduate teaching assistant had to assert his authority over a student who insisted on wearing his cap when making a presentation to the class. Since we expect professional appearance and manners, the student was asked politely to remove his cap and refused. In another case, I had to assert my authority over a student who insisted on the right to sit on laboratory tables during class. Since the student did not respect my request to refrain from that behavior (which had been called to my attention by several other students), I made it clear that even though we work together in the Cooperative Learning Center, I was ultimately responsible.

CONCLUDING REMARKS

The examples given in this chapter are based on my experiences with students in a cooperative learning environment that developed over a 10-year period in the 1990s. My overall feeling from my experiences the last several years of my career is that focusing on interactions among students in a subject-area setting was a two-way street. Students learned a lot about getting along with each other and about the subject matter. The traditional setting is a one-way street. Students may learn a lot about a subject in lecture courses, but little about getting along with others. This would not be a problem if people do not need to work effectively with others. *Getting along with others is learned behavior, however, and the need to get along with others cannot be escaped in today's society.*

Chapter 9
A Course Continuum

Cooperative learning generates a need for new integrated curriculum and course models. While we need not jump to the conclusion that lectures or lecture courses are obsolete, it is reasonable to conclude that lectures can take up too much time because passive listening reduces opportunities for active learning among students.

How can the traditional college approach be modified to make learning more effective and lecture periods more interactive while accessing information electronically? I developed a "course continuum" approach with main concepts and applications in a cooperative learning environment (Moen et al 2000); it is described after the brief review of the traditional curriculum approach below.

THE TRADITIONAL CURRICULUM APPROACH

Departments have traditionally been subject-matter oriented and students are given a list of courses to take to satisfy the requirements for a "major." Prerequisites are often listed so students must take courses in a particular order.

Professors have traditionally had the privilege of designing their courses in whatever way they felt was most appropriate. Students have been expected to have a certain amount of knowledge before enrolling (assumed or stated prerequisites), and professors have added to their knowledge by lecturing to them. By devoting a portion of their time each semester to each of several courses they were enrolled in, students accumulated knowledge in different subjects,

and when the required number of credit hours were reached, students had completed the "major."

Let's look at a different approach; a seamless course continuum in which there are no arbitrary lines between courses, no barriers to accessing information in different subject areas, and no territorial boundaries between the professors that teach the courses (Moen et al. 2000).

THE COURSE CONTINUUM APPROACH

Students often need to have knowledge from several subjects simultaneously as they complete their assignments in any course. Consider, for example, the teaching of statistics as a collection of separate courses. Students take the first course to learn the basics, the second to build on the first, and so on. Not a bad learning model, except that general biology students may be learning how to do field or laboratory research without having the first course in statistics. They should learn that statistical analyses of data are part of research protocol. So how should students be introduced to the connectedness of biology and statistics? (See page 106.)

Think of learning as a continuum that reflects the connectedncess of knowledge rather than a list of subjects to take as in a curriculum. Recognizing the connectedness of knowledge, courses can be thought of as part of a seamless continuum rather than a collection of separate subjects. The descriptions that follow are based on the course continuum I designed for students in the Department of Natural Resources Cooperative Learning Center in the 1990's.

A course continuum is a group of related courses that provide multidimensional learning opportunities simultaneously. The basic concepts in each of the related courses are presented in a concept course (the lecture course

equivalent) and the active learning opportunities are made available in applications courses (the laboratory course equivalent). The course continuum that was designed for the Cooperative Learning Center in Cornell's Department of Natural Resources is shown below.

A Course Continuum in Wildlife Ecology

NR 104: Natural History Information Management Concepts (1 credit)
NR 105: Natural History Information Management Applications (1-9 credits)
- Section 105.1: Natural History of Plants
- Section 105.2: Natural History of Animals
- Section 105.3: Decision Aids for Field and Laboratory Identification

NR 204: Natural Resource Modeling Concepts (1 credit)
NR 205: Natural Resource Modeling Applications (1-9 credits)
- Section 205.1: Biophysical Modeling in Natural Resources
- Section 205.2: Simulation Modeling in Natural Resources
- Section 205.3: Population Modeling in Natural Resources

NR 304: Wildlife Ecology Concepts (1 credit)
NR 305: Wildlife Ecology Applications (1-9 credits)
- Section 305.1: Wildlife Behavior
- Section 305.2: Wildlife Physiology
- Section 305.3: Wildlife Nutrition
- Section 305.4: Wildlife Energetics

NR 404: Wildlife Population Concepts (1 credit)
NR 405: Wildlife Population Applications (1-9 credits)
- Section 405.1: Wildlife Population Estimating Techniques
- Section 405.2: Wildlife Population Simulation Models
- Section 405.3: Wildlife Population Reconstruction Models

The basic concepts in both printed and electronic formats were made available to all of the students who had enrolled in any of the courses while in-depth discussions of the concepts were held with the students enrolled in each of the concept courses. Thus all of the students gained insights into the basic concepts and how they were related among subject areas while gaining in-depth experiences in the applications sections of the courses in which they had enrolled.

A cooperative learning environment is an essential characteristic of a course continuum because more experienced students worked with less experienced students in a learning group. This was one of the most unique characteristics of the continuum; *each student in a learning group was enrolled in a different concept course*. The learning group would select a common theme, a species for example. Each student would elect one or more applications courses and their research plans would be integrated with the work of other students in their learning group. Thus students in several courses in the continuum met at the same time and worked together on different aspects of a common topic, reinforcing the connectedness of knowledge as they participated in a seamless course environment.

An example is given below of the way in which a learning group might approach a species-based theme. Suppose that the gray wolf (*Canis lupus*) was selected as the theme. Four students—a freshmen, sophomore, junior, and senior—would form a learning group. The 1st through the 4th year students would enroll in concept courses for one credit each as follows:

1st year: NR 104: Natural History Information Management Concepts
2nd year: NR 204: Natural Resource Modeling Concepts
3rd year: NR 304: Wildlife Ecology Concepts
4th year: NR 404: Wildlife Population Concepts

The work of the learning group could be integrated as given in the following examples; many other combinations could be identified, of course.

The 1st year student provided general information on the natural history of gray wolves by writing a natural history file while enrolled in natural history of animals section (NR 105.2) for one credit.

The 2nd year student learned about computer programming by writing programs to meet the needs of the 3rd and 4th year students while enrolled in the modeling applications section (NR 205.2) for one or more credits.

The 3rd year student learned about the nutritional requirements of gray wolves by enrolling in the wildlife nutrition applications section (NR 305.3), working on a nutritional requirement model with the 2nd year student, and providing the 4th year student with information on how nutritional characteristics of the gray wolf affect reproductive success.

The 4th year student learned about population dynamics by writing a simulation model (with the 2nd year student) of wolf population dynamics that also included calculations of reproductive rates as a function of the nutritional status of the wolves prepared by the 3rd year student. The 4th year student would be enrolled in the simulation models applications section (NR 405.2).

This example shows how four students could work together on a larger problem in a seamless course environment, even though each of them had registered for

four different concept and applications courses. The students would gain practice in planning their work, working together on related problems, helping each other, providing meaningful outcomes for the others to use, and meeting individual responsibilities as part of a team. The upper division students provide leadership in a learning group and are good models for the lower division students. The freshmen and sophomore students made meaningful contributions to the group too, however, and all of the students would publish the results of their work on the electronic information system.

With this overview of how students could work together in a course continuum, let's look at the main concept-applications course combination in more detail.

MAIN CONCEPT-APPLICATIONS COMBINATIONS

The main concept-applications combination in a course continuum provides students with the basic concepts in related subject areas and opportunities for cooperative learning across course, subject and grade-level lines. The main concept courses provide professors with opportunities to give lectures and stimulate thinking through discussions of the most significant concepts in a subject area (Moen et al. 2000). The applications courses provide the flexibility and open-ended opportunities for almost unlimited active and cooperative learning. Computer-based modeling was an integral part of the applications courses (Boomer and Moen 1996, Runge and Moen 1996). The main concept-applications combination takes advantage of the power of humans to conceptualize while providing opportunities for students to apply the concepts while taking responsibility for

their own work, working with others, and publishing the results of their work as information resources for others.

The Main Concept Component

Every subject has some main concepts that can be identified as most essential for students to understand (Moen et al. 2000). Students benefit from an overview of the context and a synthesis of the main concepts when formulating questions and solving problems in a subject. Shifting from giving detailed lectures to the discussion of the main concepts can reduce the amount of time spent in traditional lecture courses by over 50%. Examples of main concepts in the course continuum are listed below.

Sample Natural History Concepts…

The concept of individuality
The concept of biological time
The concepts of abundance and distribution

Sample programming and modeling concepts…

The concept of information integration
The concept of scale
The concept of modeling
The concept of ecological significance

Sample species ecology concepts…

The concept of environment
The concept of rhythmic change
The concept of energy balance
The concept of productivity
The concept of social order

Sample population ecology concepts…

The concept of populations
The concept of population growth
The concept of population structure
The concept of population reconstruction

The concept of carrying capacity

Descriptions of each of these concepts were available as "written lectures" for all of the students enrolled in one or more of the continuum courses to read. Each student received a printed copy and the descriptions were also published on our local area network for students to access at any time.

The Applications Component

Reducing the time students spend listening to lectures by over 50% leaves more time for them to work on applications of the concepts in a cooperative learning environment. The traditional 4-credit combination of 3 credit-hours of lecture and 1 credit-hour of lab was inverted in the course continuum; students enrolled in 1-credit concept courses and 1-9 credits of applications courses. The applications component was not just an increase in the number of "laboratory" credits, however. Students could enroll and re-enroll in applications courses in successive semesters, thus enabling them to explore additional areas in one of the main concept courses or to do more in-depth research in successive semesters. No boundaries were placed on a students desire to learn more in any subject area. *Professors could guide students, the "curriculum" did not limit them and the course continuum accommodated them.*

Students could design their own research within the framework of each application section, write and publish natural history files, write and share computer models, analyze ecological functions with computer simulations and visualize population dynamics with interactive computer models. Samples were given in the overview above; the number of possibilities is literally unlimited.

The application sections also provided students with continuous opportunities to work together while applying the main concepts, to broaden their knowledge base and explore specific questions in more depth. Students were actively involved in planning their work and assumed more responsibility for their own learning. They were not only expected to cooperate with other students but also to serve as mentors, helping other students in the "community of learners" created by this approach.

Students as their own teachers. Students don't have to stop learning about a subject because college rules prohibit registration for courses a second time when a course continuum is in place. Rather, students can provide a "learning plan" that describes both the in-depth work they intend to do as they learn more about the subject, and the help they can give less advanced students while serving as a mentor. Such plans can be evaluated by student peers before submitting them to a professor for approval, giving students exposure to the ideas of other students and evaluation of the work being proposed.

Students as mentors. When students are given meaningful opportunities to help other students learn, they will invariably conclude that they learned a lot because (1) the experience provided a review of the material for them, (2) learning how other people think broadened their own horizons, and (3) working with others generated new ideas and questions for further study. I observed undergraduate teaching assistants working with hundreds of students in the 1990s and was impressed with the respect students had for each other in student-mentor relationships.

Professors as guides. What are the roles of professors in a concept-applications course combination and cooperative learning environment in a seamless course continuum?

Professors remain the single most important source of the significant concepts in a particular subject. They are also guides to thinking, a source of ideas for research, a discussion person in learning groups, an encourager of progress and productivity, a respected critic, an editor, and more. Professors need to actively participate with their students in such a cooperative learning environment; they cannot turn the teaching over to the students. It takes time to interact with students in a cooperative learning environment, but learning always takes time. The wide variety of areas being investigated by the students not only challenges professors but also stimulates thinking in new and related areas. *Being a professor in this kind of learning environment is much more emotionally demanding than the traditional lecture environment, but it can be much more rewarding.*

Interacting with students. One reason that passive learning from lectures is less effective than cooperative learning is that students spend less time interacting with other students and professors. Professors can give a lecture and retreat to their office rather than continue to interact with their students. But can professors get any work done if they are so involved with their students? *Interacting with the students <u>is</u> a professor's work.* Teaching and learning are both much more fun in a cooperative setting, and the professor's impact is multiplied when students have opportunities to be both learners and teachers.

Electronic information systems. One of the key supporting components of the main concept-applications combination is the availability of electronic information resources not only to be accessed but also as a publishing outlet for students. On-line services provide access to information worldwide, and an electronic information system can serve as a local publishing outlet for students in different courses and subject areas. Teaching and learning have not

met their potential for long-term impacts in the past because the products have been discarded at the end of a course. Discussions have gone unrecorded and conclusions have been lost, term papers have been graded and discarded, and tests have been temporary evaluation tools rather than long-term learning tools. Student knowledge is too valuable a resource to be so temporary, however. Publishing student work on an electronic information system retains the productive work of students so it is available to students in the future. Designing tests that reside on an electronic network gives learners opportunities to test themselves whenever they want to, learning as they do so. *Increasing the long-term usefulness of learning resources is guaranteed to increase the quality of the learning products produced by students.*

ELECTRONIC PUBLISHING OPTIONS

With the feasibility of Web-based publishing, it is possible for students to share their work with other students around the world. Rather than having an underground network of term papers for sale, electronic publishing by students should be promoted as a legitimate educational activity. A two-level system could be used in which all of the students would be expected to publish on a local area network and the best publications would be placed on the Web. This would provide incentives for students to do their best because they would be rewarded not only with recognition but also by having the satisfaction of sharing their knowledge with students in other colleges and universities. Thousands of professional journals will be published on the Web in the future and student authors should begin participating in the process in a controlled educational learning environment

The Role of Hypertext

Hypertext links between publications enable readers to jump from one place to another at the click of a mouse, satisfying an immediate "need to know" as nothing else can. When a learner comes across a word, concept, or technique that needs to be explored further, going to the dictionary will not be able to compete with the instant gratification provided by hypertext links. *Hypertext links are about the only way that students will look up a significant amount of cross-referenced materials.* Let's look at some examples of how it might work in relation to the "need to know" about statistics.

Probability example. Probability is a central concept in statistics, and it can be introduced in, for example, general biology in relation to genetic concepts. Students need to learn something about probability in order to understand some genetic inheritance concepts. While this has been done in the past by teachers who have prepared the necessary supporting material, an integrated information system approach makes it possible for students to use hypertext links to access probability concepts and applications when they are needed. This biology example is just one of many examples where students benefit from being able to access related material when they need it rather than overlooking it until they "take a course in it" or depending on the teacher to call it to their attention. *Professors should collaborate when preparing course materials so links are found wherever appropriate in the information resources students are using.*

Paired and unpaired t-test examples. The t-test is a commonly used statistical procedure for determining the probability of two data sets being from the same population.

The paired t-test can be introduced in ecology by having groups of two students make separate measurements of some meaningful parameter in the field, enter the data and complete the paired t-test on-site with a portable computer. The results are available immediately for interpretation and discussion. If students do not understand the assumptions underlying t-tests, the distribution of probabilities of the t-value, or why their results were statistically different or not, supporting information should be available on the portable computer so students can make the measurements, do the test, and understand the results of the test *while at the site of the measurements in the field.*

Think of the potential for learning when students are actively involved in a cooperative learning environment and hypertext-based information resources are there at the click of a mouse. Students can access what they need to know when they need to know; *no need to wait for a course in any subject when there are, theoretically, no barriers to learning.*

Personalized Information Systems

While there is a vast amount of information available on the Web, it may be desirable for professors and students to work together on a more personalized information system that is designed to provide support for the local learning environment. Just as a list of terms with their definitions might have been distributed as a handout in the past, a more comprehensive information system could be made available on a local area network now. Teachers need not wait for others to author such resources or for commercial products to become available. Since teachers do not have time to prepare all of these information resources for their students, the alternative is to work with their students to develop the

resources. This was the approach I used in my ecology and management courses in the 1990s, and it resulted in the "*Resource Ecology and Management Information System*" in the Cooperative Learning Center (Moen et al. 2000).

Teachers benefit from this cooperative approach by sharing responsibility for preparing information resources with their students. Students benefit from sharing information with their teachers and other students. Both teachers and students, benefit by having the information available when it is needed. *There is so much to learn from using integrated information resources in a society that is becoming more dependent on electronic information transfer as the primary means of communication.*

Seamless Disciplines

The material up to this point in this chapter has focused on a course continuum within the field of natural resources. The approach can be expanded to include relationships between additional subject areas; electronic information processing does not recognize boundaries between traditional subject areas and administrative departments. Natural sciences should not be separated from social sciences because people are the common element in both. How people act and interact socially and globally affects the natural world, and students should learn about these effects by integrating knowledge from other subject areas. Links between large subject areas as natural science and social science make a tremendous amount of information available at the click of a mouse.

Basic and applied research. There has been a long-standing debate over basic and applied research, although the reason for the debate is often not well understood. What is there to debate? Using an either-or approach, we are forced

to choose. Using more complex logic, we recognize that basic and applied research are both part of a continuum that is not simply sequential, but involves feedback as research results are used and new questions raised. *Simple either-or logic divides us, while recognizing complex logic and a learning continuum unites us.*

Science and the history of science. It is traditional to offer science courses that focus on a particular science, and "history of science" courses that focus on, you guessed it, history. But should science and the history of science be in the separate disciplines of science and history? Why make students wait to take a "history of science" course to learn about the historical context of some aspect of science? Why not incorporate history into science courses and science into history courses as part of a learning continuum? *Links provide instant access to both historical and scientific information, wherever appropriate.*

New administration models. It will be hard to institute new learning models without changing some administration models too. Awarding a certain number of credits in relation to the number of lecture and laboratory periods each week has been a useful practice. If courses become more seamless, learning will still occur in proportion to the time invested, but the time invested will not be packaged as neatly as "three lectures and one lab per week" for four credits. Learning in different subject areas will occur in relation to more integrated and student-defined learning. *Perhaps the time has come to award credits based on measurable outcomes rather than by hours enrolled.*

Authentic assessment. Improving evaluations of what students have really learned should be a high priority. Evaluations of students on the basis of their professional-level involvement and productivity in a cooperative learning environment represents an authentic approach, similar to that

of a supervisor's evaluation of an employee in a professional setting (Moen et al. 2000). In a cooperative learning environment authentic assessment is an ongoing activity because "every event is a test." *I felt that my evaluations of student performance in the cooperative learning environment represented their abilities better than scores on a test would.*

CONCLUDING REMARKS

The cooperative learning environment and course continuum described in these two chapters were designed to promote the professional development of undergraduates. Students learned about the most significant concepts in short lectures and discussions, and they applied these concepts in cooperative learning groups that designed and completed field and laboratory research. Undergraduate teaching assistants and senior wildlife management students coordinated the activities of the learning groups and supervised the student research, learning about personnel management by active participation in leadership roles (Moen et al. 2000). Publication of research results on a local area network enabled students to share what they had learned with their peers. Based on the experiences shared with me by graduates who were in professional positions or graduate school, this approach gave them many advantages over those who had participated in more traditional curricula. *The information revolution with all of its technological advances should force some major changes in learning environments, evaluation of learners, and administration of departments in colleges and universities in order to prepare students better for the more dynamic and interactive careers they will likely have as professionals in the 21st century.*

Chapter 10
Making the Commitment

"Throughout most of human history…hardly anything changed for centuries at a time...the future was the past" Perelman (1992). Now, students prepare for futures that will be different from the past because we are in an information revolution and live in the information age. It is imperative that we look closely at how educational practices prepare students for the future.

MAKING A PHILOSOPHICAL CHANGE

It seems obvious that learning is natural, but have we built that logic into learning environments at the college level? Is learning natural when large numbers of students assemble and a professor tells them what he or she knows? Is learning being respected as a natural event when professors give assignments as isolated entities without considering connections to other courses, other time commitments, and other legitimate life experiences of students?

Professors will quickly point out that it is impossible to make assignments while giving consideration to all of the other activities in a student's life. This is true, but the main point of the previous paragraph is missed if that argument is used. Professors cannot make all the connections and consider all of their student's life experiences that enter into the educational process. *The alternative is to turn more of the responsibility for learning and for time management over to the students.* They are the ones who are in a position to make these considerations, and students will soon learn that, in a pluralistic society, they cannot have their own way.

They must learn how to learn, and learn how to work with others. *"To have any hope for a genuinely productive restructuring of learning systems, the learner as consumer* [my emphasis] *must be the overriding focus"* (Perelman 1992). How should we prepare the next generation of social human beings for successful lives in the information age?

Professors have few models to follow other than the text-lecture-test teaching method. Research shows, however, that exclusive use of the lecture constrains students' learning (Bonwell and Eison 1991). Little attention is given to that conclusion when course enrollments and contact hours are used to distribute teaching assignments in colleges and universities. *Movement away from professor-student ratios toward more student-centered learning is movement in the direction of more effective learning.*

Student-centered learning models are the exception rather than the rule in higher education. Would a thorough long-term economic analysis show that lecturing is the most cost-effective model? Learning cannot be adequately evaluated by thinking of teaching as a production line job that is finished when a course ends and grades have been assigned. Rather, learning should be evaluated in relation to *the costs and benefits that accrue during a lifetime.*

A New Way of Thinking

The lecture approach has been effective in the past and information delivery by lecture can be even more effective with the use of dynamic visualizations. But is using the lecture approach as the main method of instruction by college teachers good enough for the future? The possibilities for change are real; Fogarty and Bellanca (1992) describe the new lecture as a myriad of interaction patterns

that take the focus off the lecturer and put it squarely on the learner.

Schools and colleges were almost totally isolated from the information revolution that began a few years ago, according to Perelman (1992). While that statement was made 10 years ago, there seems to be considerable truth in it now since lecturing by professors and note-taking by students continues as it traditionally has. Using computer projections instead of slide projectors while giving a lecture is not an information revolution. The information revolution is not about making lectures better. *The information revolution is about information processing, creative thinking and computer-enhanced problem solving at levels that could not be imagined a few years ago.*

I began imagining the potential for dramatic changes in education when the personal computer appeared in the 1980's. I have been wrong about that potential many times, and it has always been in the direction of underestimating the potential. From 10 megabyte hard disks to gigabytes...64K RAM to 16 megabytes...$15,000 to $1,000 for a computer...50 pounds to 5 pounds...students can do things now that were beyond our wildest dreams a few years ago. My undergraduate and graduate education has served me well, but the higher education that prepared me for the last one-third of the 20th century is not good enough for students who will work in the first half of the 21st century.

Think of changes in information access with the growth of the World Wide Web, in communication speed and in our ability to accumulate, evaluate, and use information to produce new knowledge and enhance understanding. Changes in technology mandate changes in the characteristics of a relevant education, not for the sake of technology but for the effective use of technology in the future.

New approaches to higher education shouldn't just be better, they should be much better because students today will work in a much more complex world tomorrow. There is so much more information rapidly available because of electronic access to library resources and communications, and more access requires more careful discernment of the value of the information. The value of legitimate information increases when it is connected to other information and the connections between information becomes more real with each increase in information processing power. The last generation dealt with a mechanical revolution and *horsepower*. *We are dealing with an information revolution and mousepower*.

Reasons for Changing

Efficiency in teaching should not be our goal; effectiveness in learning should be. They are measured by different standards. "*Education is the only business in which the consumer does the essential work*" (Perelman 1992), and he continues with "*...the productivity of the student or learner—not teachers or administrators—is what really counts."*

Efficiency in teaching has been measured by such things as student-faculty ratios, credit hours taught, and the number of students graduating compared to the number of students entering. Efficiency measured by these standards can be enhanced by having professors teach several large courses, and by having students graduate as soon after matriculation as possible. Admitting transfers at the junior level enhances that statistic for a university.

Efficiency in learning is measured by criteria that are more difficult to assess than faculty:student ratios. Those who learn the most in a four-year course of study should be

the most successful later in life. But how is success measured? Measurements of success may have to wait years for results; success is not an instantaneous event but a sequence of life-long occurrences. No wonder it is easier to make a calculation at the end of a school year and distribute statistics about an institution's educational efficiency by focusing on teaching! *Improving efficiency in teaching is not the same as improving efficiency in learning.*

Should we even "teach?" No, if teaching is the "delivery of information." Yes, if teaching is interaction with students who are learning how to assume responsibility for their own learning. *We should provide an environment that maximizes learning, and that requires a psychological change by both teachers and students.*

MAKING A PSYCHOLOGICAL CHANGE

Making a philosophical change is easy relative to the psychological changes necessary for implementing a more student-centered learning environment. Part of the reason for the difficulty lies in the strength of past and present models.

Giving up Center-stage

Professors have a captive audience and can be on center stage not only to educate but also to entertain, with considerable freedom of expression. Are some of us teachers because we were not good enough to be actors and actresses? Maybe not consciously, but center-stage teaching can be ego satisfying. Maybe some of us are teachers because we were want political power. Teachers can impose their viewpoints on captive audiences with little fear of

backlash because opportunities for negative responses can be easily controlled.

Hopefully, most of us are teachers because we feel rewarded when helping others learn. And how can we help our students the most? *By giving up center-stage and focusing not on how much we teach but on how much our students learn.*

Giving up Power

Giving up center-stage may cause teachers to feel that they are also giving up power while still being held responsible for their courses. Teachers like to be in control, to have students do what they are asked to do, and to have their students view them as an authority figure. The ideal students just "do their work" without complaint. Or do they?

Giving up center-stage does not mean that control is lost or that respect for authority decreases. Rather, it means that teachers transfer meaningful responsibilities for learning to students, which <u>increases</u> their respect for teachers. If students do not feel responsible for their own learning, they will not only continue to look to teachers for guidance but will also place the blame on teachers when something goes wrong. Giving up power and transferring responsibility for learning to students does not mean that the learning process is uncontrolled (Cohen 1994); students know that they are ultimately accountable to the teacher. *The paradox in a well-designed cooperative learning environment is that while the teacher appears to give up power, the power actually increases when teachers become problem-solvers <u>with</u> the students and create an expectation of learning <u>by</u> the students.*

Having a genuine setting for sharing authentic rewards with students is also very important. Such rewards may be a

smile at the right time, a word of encouragement, meaningful congratulations on a job well done...students are quick to recognize and appreciate these rewards. Thus teachers increase their influence in a cooperative learning environment because they do not make students learn, but create an environment in which students want to learn. The former requires authority, the latter requires influence. *When a class or a course is over, authority dissipates while influence can last for a lifetime.*

WHERE DO WE LOOK?

Suppose a college professor is interested in making the commitment to more dynamic, natural, interactive, problem solving teaching. Where should one look?

Don't Look Back

There are many obsolete learning models from the past and fewer models suitable for the future. We may have our favorite professors from a generation ago, and they were undoubtedly fine people and effective teachers, but they were not educating students for the 21st century. Technology has changed, and *the way information is accessed, evaluated, and integrated in relation to how students learn, solve problems and make decisions is different now.*

Look for Logical Learning Premises

If learning is natural, then there must be some logical learning premises. One, humans are biological organisms with a number of innate rhythms, genetic blueprints, and social beings who are almost always engaged in some form

of group dynamics. Two, individuals have their own mindsets and are typically egocentric, enjoying recognition and rewards. Three, individuals are conditioned by their environments, which means that they can be conditioned by manipulating their environments. *The teacher who develops a cooperative learning environment is promoting positive changes in the effects of environment on student learning.*

Look to Students

One of the less likely places that professors look for knowledge and direction is the students. Professors know more about some things than their students do but a professors role is not to prove he or she knows things that they do not know, but rather to share what is known with them. The students, in turn, can share what they know with the professor and with each other because students are collectively more knowledgeable than professors because they are more current in many subject areas and they are many, and many minds are better than one. For example, I studied plant physiology 30 years ago. Some of my students were studying it while enrolled in my course. I remember only a little of what I learned then, and what I remember may be irrelevant now in light of current knowledge. Learning with my students as we worked together on ecological questions that involved plant physiology benefited us more than if I had limited their thinking to my knowledge of plant physiology.

Students are readily available sources of knowledge and intellectual creativity and professors should to capture these intellectual resources and share them in a larger knowledge domain, not only in our courses but also in related areas of study. *There is no shortage of potential connections between*

the knowledge domains of students and professors who work together in a cooperative learning environment.

THE NET COST OF INNOVATION

Making the transition from the traditional to a cooperative learning environment in college may seem like an expensive proposition. Actually, one gets "more for less" when moving in this direction (Moen and Decker 1998). Since the technology used for information processing is changing rapidly, innovation in education is necessary to prepare students for the future.

The Main Challenge

The main challenge facing innovating educators is getting "more for less." More knowledge, more understanding, more problem-solving power…in less time because we can process information faster and at less cost by maximizing the efficient use of human resources. Having students help each other maximizes the efficient use of human resources. The professor cannot do it all alone! Having students publish their work on a local area network or on the Web makes it available for others to learn from in the future; this is maximizing the use of human resources. Writing a term paper and throwing it away after it has been graded is a waste of human resources. To summarize, *having students actively involved in their own learning and sharing with others maximizes the efficient use of human resources.*

The Net Cost

More learning for less financial investment reduces the net cost of innovation. How does one reduce the financial investment? By changing the learning environment so

students help rather than compete with one another, by establishing a group of undergraduate student teaching assistants who help the students each day and also edit their writings, by spending professorial time helping students become life-long learners rather than passive listeners…none of these cost any extra money! They are behavioral changes that can be made within the typical higher education setting. The undergraduate teaching assistants who had such a central role in the success of the Cooperative Learning Center contributed the equivalent of about $25,000 worth of time each semester while earning academic credit rather than dollars for their efforts. *Most importantly, they became better students, a wise investment in their future.*

FOLLOWING UP ON THE COMMITMENT

No matter how sincere our commitment as teachers may be or how determined we are to make the learning environment for our students more natural and interactive, there will be frequent doubts because of the slow pace cooperative learning seems to take at times. *One can cover the material for the students much more quickly than one can uncover the material with students.*

It is easy to doubt the value of cooperative learning activities when students grope for answers that professors have already. It is easy to doubt the value of small discussion groups trying to define a word when the professor could quickly tell them the "right" definition. The value of learning groups designing their own experiments will be doubted when all of the students could be assigned to do the same experiment. The value of problem solving by learning groups will be doubted when professors could tell them the answer and "save a lot of time." But what are we trying to

teach our students? What do we want them to learn? *Do we want them to remember an answer without learning how to ask the question, or do we want students to learn to ask questions and solve problems they have not dealt with before?*

A recent graduate who had been on the job for less than two weeks told me *"You are on your own on the job; you have to figure things out for yourself."* How could I know in advance what she needed to know in her job when I had no way of knowing what job she might have? *Investing time in developing thinking abilities is about as risk-free as one can get.*

CONCLUDING REMARKS

Participation in higher-order thinking and problem-solving skills in a cooperative learning environment is the best investment of time by learners preparing for careers in the 21st century. Parts of my knowledge domain became part of the students' knowledge domains when we worked together, and the students produced many resources for other students to use. The students were not limited to what I knew, nor did they drift in a world of vague ideas searching for ways to cooperate. They had meaningful experiences while working together and they learned about each other, about different subject areas, and about themselves. *Most of my students did not go on in my subject area, so the extent to which I helped them conceptualize, think, and solve problems was more important to their future success than the academic content of my courses.*

Chapter 11
Making the Transition

Making the *commitment* to change from the traditional text-lecture-test format to a cooperative learning format is a decision; making the *transition* requires action. The decision to make the commitment can be made in a moment, but the transition from professor-centered lecture to student-centered cooperative learning takes time. The commitment to change is the important first step, and *students will begin to benefit as soon as measures are taken to involve them more actively in their own learning.*

ATTITUDE ADJUSTMENTS

While making the commitment is based on philosophical and psychological changes, further attitude adjustments will be needed when making the transition. Professors have been professors too long and students have been students too long…the models have been in place for generations…for the transition to be quick and easy. *Will, not wealth...is the key to innovation (Perelman 1992).*

Deprogramming Professors

Professors have prepared their lectures, assigned term papers, tested the students, read the term papers, scored the tests, and assigned grades in the traditional classroom setting for so long that the traditional model is the only one most professors have experienced. Professors may be reluctant to stop delivering information by lecture because the students need to hear this "set of lectures" before they will know how

to solve the problems. It is easier for professors to continue delivering information by lecture than to begin thinking of student learning as the main focus. It is not easy to move toward cooperative learning in higher education because *professors traditionally cover the material <u>for</u> the students rather than uncover it <u>with</u> the students.*

Traditional lectures on a college-level subject take up so much class time there is little left over for solving problems with students. If professors try the cooperative approach, however, they may find, as I did, that Fogarty and Bellanca (1992) were right: *"...once teachers begin implementing cooperative interactions, the evidence of student motivation becomes so overwhelmingly visible that teachers are encouraged to try it more."*

Some Lecture Period Ideas

Suppose a professor would like to be sure the students know some significant facts or definitions. Giving them a quiz but rather than grading them, having the students compare their answers with those of other students helps them gauge their knowledge level. Discussing correct answers with the class after they have evaluated their own answers insures that all students have the correct answers. This can be a better learning opportunity than giving the traditional quiz and having the students hand them in to be graded.

Suppose a professor has just given a 10-minute lecture on a significant concept. Having students share their understanding of the concept in groups of three students helps them reinforce what they heard, or thought they heard! A summary statement on a 3x5 card might be handed in with the names of the students in the group, providing accountability, an important part of cooperative learning.

Suppose a professor would like the students to review their understanding of a particular calculation. Students can pair up and give each other practice problems and then compare their answers. It is interesting to me that going to the blackboard was great fun in grade school, and I found out that Cornell students enjoyed paired-up exercises at the blackboard too!

The activities described above are three examples that worked well in lecture periods. Many more small group activities can be identified and used even in large lecture halls where students are lined up in rows. Varying the format and timing of such interactions among students makes lecture periods more interesting.

Deprogramming Students

Some college students like to be told what to do, when to do it, how much to do, and what they need to do to receive an A or a B or to pass the course. Some educators suggest that expectations should be clear and concise. Some professors allocate different fractions of the final grade to different requirements in the course. Students like that approach because they know just what each assignment is worth, and may even try to "beat the system" by allocating different amounts of their effort to different requirements. *This is counter to what learning ought to be about!*

Teachers have assumed responsibility for student learning for so long it is hard for students to assume that responsibility for themselves. When I first started to use the cooperative approach one of the students who did not like the approach said to me *"I am still too much of a student."*

Cohen (1994) lists the norms for traditional classrooms as: Do your own work, do not ask for or give advice to another student when doing an assignment in class; pay

attention to the teacher; keep your eyes toward the front of the room; be quiet...*it is no wonder that students need to be deprogrammed when they encounter a cooperative learning environment for the first time!*

Hamm and Adams (1992) summarize the attitude changes needed by students in a cooperative learning environment, pointing out that *"getting over years of learned helplessness takes time."* Students have been conditioned to think that the teacher is there *"…to validate their thinking and direct learning."* Students have been *"constantly compared with one another for grades and recognition."* They expect from teachers *"direction on the smallest detail..."* As Hamm and Adams pointed out, and I experienced this too, unlearning these dated learning models takes time. Cooperative learning has become more common in elementary and secondary schools in the last two decades, however, so future college students may be introducing cooperative learning to professors!

Gaining the Confidence of Students

How can professors gain the confidence of students while deprogramming them? Students should not be told they are being deprogrammed because they will raise their defenses immediately. It is better to *demonstrate the fun and effectiveness of the cooperative learning approach by telling them this class will be "...somewhat different from some other classes you have had."*

Consider the following premises for gaining the confidence of students:

- *Learning is natural, so let's demonstrate that.*
- *Cooperation is natural, so let's work together.*
- *Discovery is natural, so let's discover things together.*

- *Learning is fun when we feel a sense of accomplishment.*
- *Sharing what we have learned with others is rewarding.*
- *Solving meaningful problems together is satisfying.*

Focus on student abilities. Learning and thinking are natural and fun when we focus on student strengths rather than weaknesses. Providing students with problem-solving situations appropriate for their level of knowledge gives them opportunities to use the abilities they have, *which inspires them to develop their abilities further.*

Provide support and encouragement. Students and teachers all thrive on encouragement. There's no reason to rush into "giving grades" for student work early in a semester when encouragement would be much better. Rather, support their efforts by showing interest in what they are doing and giving them help when it is needed. *Giving low grades early in the semester in order to get the students to work harder is more risky than providing support and encouragement before assigning any grades.*

Focus on what is right. Focusing on what students have done right before pointing out their mistakes encourages students to do better. Helping them improve demonstrates that mistakes are steps rather than barriers to learning. *If students are confronted with their mistakes before they hear anything good about what they have done there is a high potential for barriers to form between student and teacher*.

Have students improve their own work. After first encouraging students and then helping them learn what is not quite right in their work, have the students assume responsibility for improving it. Give them the responsibility for finding the grammatical error they might be making throughout their writing rather than marking every occurrence for them. Give them the responsibility for

checking the answers to their calculations rather than correcting their papers for them. Professors should help students take responsibility for assessing and correcting their work because they will have to assume that responsibility in the future. *Nurture independence, not dependence.*

Give students responsibility. Give students as much responsibility for their own and each other's learning as possible. College students welcome responsibility and they need experience in accepting responsibility and in managing their time. Assignments can be barriers to learning *if they do not give students enough responsibility for defining their own work and for managing their own time.*

Don't expect to know everything. A cooperative learning classroom, where students are responsible for so much of the learning, is like having almost as many laboratory sections as there are students. Professors cannot be expected to know everything when so many different learning activities are taking place. There is no shame associated with not knowing if professors work with students to find answers. *Teachers gain the confidence of their students by learning with them.*

CLASSROOM ADJUSTMENTS

Making the transition from traditional lecture to cooperative learning in the college classroom can be done in many ways, and there is no single set of steps to follow. It is not easily explained either because so many dynamic processes are involved, *"...many of which are so broadly distributed and intangible that they are practically invisible"* (Pereleman 1992). The Cooperative Learning Center in Cornell's Department of Natural Resources (Moen et al. 2000) looked like an ordinary laboratory with some computers in it; *what went on there was different*.

Cooperative Learning by Design

Effective cooperative learning environments are created by teachers who recognize the framework needed in relation to both the students and the material being learned. Professors plan to have groups discuss an idea or concept in a lecture period. Professors plan to use short-term work groups to accomplish specific shared tasks. Professors plan to have long-term productivity groups make significant contributions to the information resources used by students in several related courses. What are some of the main steps in planning a cooperative learning environment? Consider the following:

- *Identify topics of appropriate size and complexity.*
- *Prepare plans and then have students identify the goals.*
- *Identify with the students the knowledge and skills needed to meet the goals.*
- *Implement the plans with everyone in the workgroups participating.*
- *Prepare products that provide tangible evidence of learning.*
- *Evaluate the products, emphasizing self-evaluation by the producers, the students.*
- *Publish the products so others will learn from the work.*

Identify realistic and meaningful problems. Students can work together on realistic and meaningful problems that provide meaningful results for use later. An example from my field...making calculations of energy metabolism and fat mobilization of representative black bears in winter dens is better than making up a set of numbers just to put students

through a calculation. Groups of two to four students can work together on designing the calculations. They must determine how much black bears weigh, the energy content of fat, the body composition of bears in the winter, the metabolic rates of bears in dens, and the number of days black bears spend in their dens. These parameters are necessary for the calculations, but the numbers used by different groups need not be the same. *It is more interesting to represent small and large bears, lower and higher metabolic rates, and different numbers of days in the den and then compare the results than to have all the students use the same numbers to see if they all get the "right" answer.*

Have a complete framework. Follow through on cooperative learning activities from ideas to final products, giving students something to be proud of as tangible evidence of their work. The black bear calculation mentioned above begins with a discussion about how bears depend on their fat reserve in the den; the concept of energy balance (see page 101). This is followed by preparing worksheets with the sequence of calculations, designing computer models, writing supporting text files and publishing the information on the local area network. The final product should be so complete and well written that other students will understand both the concepts and the outcomes after reading the text files and using the computer models. It is not necessary to "teach" this black bear material to new students each year since the published files would be available for students in the future. New students should work on another species or on new problems, adding information resources to the electronic publishing system.

Model experiments. Laboratory periods, which are usually longer than lecture periods, provide many opportunities for cooperative activities beyond the typical

"lab partner" approach. Every group need not work on the same experiment, for example. Different learning groups can work on different experiments and share the results with the class. Small groups can do model experiments that illustrate a particular result that will be useful for all the students later in their own research. A model experiment should include a planning phase, time for learning to use equipment, collecting and analyzing data, and writing a professional-quality report for publication on the information system

Design problems. Design problems are ideal for cooperative learning because students can share ideas and come up with a collective design that has more features than individual designs would have. When groups of students work together on design problems, competition between groups develops naturally too. Students look forward to such competitive challenges and having design contests provides special recognition of winners.

Risk-taking is okay. One of the hardest traditions for students to overcome is the fear of being wrong. Students need opportunities to learn that risk-taking is okay if they learn from their mistakes! As students assume more responsibility for their own learning, being wrong will be a natural part of learning. Students in cooperative learning environments are not matching wits with teachers but are working with their teachers in a community of learners who solve problems together, make mistakes, and learn more while understanding relationships better.

Guidance needed. Guidance by teachers, teaching assistants, and student mentors is needed when students are introduced to a cooperative learning environment where information resources and learning are shared. They will not know what responsibilities are to be met and what roles are

to be assumed at first. They will not assume roles as recorders, encouragers, and reporters unless the roles are explained and practiced in discussion groups. Assuming roles, fulfilling responsibilities, and publishing their work are all meaningful assignments, different from "read pages 80-100 and write a report to turn in next week."

Quality control. Quality control is essential if student work is to approach professional standards. Rather than have the students turn in their assignments to see how well they have done, the cooperative approach promotes professional quality by mutual help and support. Students and teachers alike strive for quality when planning group meetings, discussing ideas, and when doing the research and writing the reports. Quality reports involve more than good writing. Files may be well written, but if they are based on incomplete literature searches and poorly designed research, they do not meet the professional standards expected when the files are to be shared with others. Teachers have always had high expectations of their best students; *why not design a learning environment where all of the students have high expectations for themselves?*

Discuss success. Cooperative learning environments grow in effectiveness when students benefit from their success as individuals and as groups. It is so much better to focus on what is right than to focus on what is wrong with student work. Discussions of improvements needed are more effective after recognizing the good parts of a student's work. It is important for students to accept responsibility, not only for their failures but also for their successes, recognizing that the quality of their work depends on them and not on the teacher's corrections. Students should save drafts and notes recorded during discussions to help them realize that they are held accountable for improvements in their work. They will see the improvement when they

compare early drafts of their writing with the final copy. *When students see tangible evidence of the improvement in the quality of their work they will have more pride in the final product.*

Skills Needed by Professors

Lecturing is the main skill expected of professors in the traditional college classroom. Shortly before I retired I received an announcement of a workshop on "how to give a better lecture." While it is true that if professors are going to give a lecture it ought to be a good one, many other skills are needed to be truly effective college teachers. Cooperative learning environments require several new skills—none of them difficult—and some of them are discussed briefly next.

Personal contact skills. Knowing the first names of students may not be considered a skill but it is an important part of a cooperative learning environment. The eye contact professors make with students, how professors respond to student's ideas, how criticism is given, how students are encouraged...all these personal contacts have major impacts on how students react in a learning environment. Positive professor-student relationships are critical in a cooperative learning environment because professors are models for students. *The success of a cooperative learning environment depends on personal interactions among students and teachers.*

Listening skills. Teachers are such a traditional source of information that it may be hard for them to listen to students. Further, professors have authority over their classrooms and the power to enforce the rules. Professors are responsible for assigning final grades, not the students. *Truly listening to students and making them part of the professors*

ultimate responsibilities will be a new experience for many college professors.

Nurturing learners. A critical information mass may be needed before a subject begins to make sense to students. Professors need to nurture their student's understanding by helping them reach that critical mass, exhibiting leadership by sharing from their general knowledge and years of experience. The basic concepts discussed in Chapter 9 can be considered the critical knowledge mass the students should be familiar with. Upon reaching such a critical mass, students begin to "catch on" and *both professors and students move toward every teacher a learner and every learner a teacher as they apply the concepts to new situations.*

Organization skills. Cooperative learning environments require more organization than preparations for traditional lecture courses do. The subject matter, cooperative activities by groups of different sizes, roles of teaching assistants and interactions with students all require organization in cooperative learning environments. They are meaningful components, however, because such organization is much more similar to the workplace than the lecture hall. Having a group of students who believe in the value of a cooperative learning environment makes it fun because learning becomes a cooperative effort among teachers, teaching assistants, and students. *Cooperation extends to all members of cooperative learning environments.*

Observation skills. Cooperative learning requires that teachers and teaching assistants be good observers so they can step in to help students, encourage them, correct them, and redirect them at appropriate times in their group work. Done too often or at the wrong time, students will revert to dependence on the teacher. Done properly at the right time,

students appreciate help that enables individuals and groups to move forward more effectively.

Encourage self-evaluation. Teachers should set the stage for effective self-evaluation. For example, instead of saying to a student author *"The introduction to your paper was good"* we might say *"What is it about the Introduction that makes it so good?"* Asking the latter question encourages self-evaluation while the former does not. *Self-evaluation is a prerequisite to self-correction.*

Encourage self-correction. It is essential that teachers encourage self-correction by students. This places the responsibility for learning on the students, where it belongs, When students are accepted as real people who can do meaningful things in a cooperative setting, they will want to be more responsible for their own learning, for their own time management, and even for their classmate's learning. *Patience will be necessary as mistakes are observed, but that's expected when working with people in any setting.*

Conflict resolution. While the phrase "cooperative learning" infers the presence of cooperation and the absence of conflict, more opportunities for conflict are created in a cooperative learning environment than in the traditional learning environment. This is not unlike life in general, however. *Learning how to resolve conflicts is one of the most important learning experiences students can have in a cooperative learning environment.*

Skills Needed by Students

Students need to acquire many new skills when they assume more responsibility for their own learning. The professor's role shifts from spending many hours of time preparing lectures to spending much of the time helping students learn

how to accept that responsibility. Some specific skills are introduced below.

Finding relevant resources. Students need to learn how to use the electronic tools effectively when finding relevant information resources on-line and in libraries. Not everything that has been published is listed in electronic card catalogs so they may have to combine manual searches with electronic searches. They also need to be reminded that not every bit of information available is valuable. *Students need to know how to find and evaluate the quality of information resources.*

Thinking skills. Fact seeking and data collecting are lower-order thinking skills; solving problems is a higher-order thinking skill. Students should learn to recognize relevant factual data, evaluate the data, and how to use data in problem solving. *Students should learn both the "how to" and the "why" in cooperative learning environments.*

Sharing information. Sharing information is a natural human activity, but many of the skills needed to share effectively must be learned. In traditional learning environments, where teachers are central and students work alone most of the time, students have few opportunities to practice these skills. How to find facts efficiently, how to share facts appropriately, how to express and share opinions respectfully, how to prepare plans and publications together...*all of these sharing skills are important in cooperative learning environments.*

Managing resources. Students have few opportunities to manage their own time in traditional classrooms because they are usually told what to do. They might think of themselves as "good" students because they wait for the teacher to give the instructions and then they follow them. The question I heard most often from students when they were first introduced to cooperative learning was *"What do*

you want me to do?" Helping students learn how to manage the two resources that we all have to work with in any subject—information and time—is one of the most important outcomes of a cooperative learning environment. As students get better at managing these resources, they learn more about the subjects they are studying, and *they are being prepared for life-long learning.*

Decision Making skills. Students have many opportunities to practice decision-making skills in a cooperative learning environment because so many group decisions must be made. Some of the decisions pertain to the subject matter and some to social interactions. Students should learn about and practice different ways in which decisions can be made because there will be many opportunities to practice these skills in a cooperative learning environment. *Students who acquire these skills in cooperative learning environments are often frustrated in traditional courses where the professor assumes responsibility for all of the decisions*.

Social Skills Needed by Both Teachers and Students

All of the skills listed separately above under teachers and both teachers and students are common to both groups. Being polite to others, sharing ideas and listening to others, accepting group decisions gracefully and saying "thank you" are some common social skills that are an integral part of cooperative learning environments. It is easy to assume that both teachers and students have these skills, but do they?

Saying "thank you." Sure, we know how to say *"thank you,"* but do teachers know *when* to say thank you to students? Do we thank them publicly for contributing an important idea to a group discussion? Do we thank them privately for showing understanding in a group discussion?

Do we thank groups for their final reports? *Hearing a sincere "thank you" from their teacher is always an encouragement to students.*

Accepting group decisions. This may seem like a student-skill rather than a teacher-skill, but what does the professor do if a group of students makes a decision that is quite different from the expected, and maybe even less desirable? Unless there is an element of danger involved, the professor may have to accept the decision and let the students learn from the experience...and that can be hard to do gracefully. *But if professors expect their students to accept group decisions gracefully, then professors should too.*

Listening and sharing. It is sometimes hard to be a good listener. Both students and teachers are inclined to interrupt when someone else is sharing an idea or expressing an opinion. I had a telephone conversation recently with another professor who, as soon as he thought he had an idea of what I was going to say, began responding to my anticipated ideas. It was frustrating because I could not finish expressing myself, and his anticipation was not always correct. Learning to give courteous attention to speakers, listening patiently, planning responses well...cooperative learning gives both teachers and students many opportunities to practice these listening and sharing skills. *Being a better listener results in a higher level of consciousness and courtesy by everyone involved*.

Being polite to others. Who isn't? Well, sometimes professors aren't, and get by with it because of their position of authority. They don't have to say *"I am sorry I do not have time"* because they can get by with saying *"I don't have time."* However it is said, it is a model for students, and the first of these two phrases is a better model than the second one. A cooperative learning environment provides

students with many opportunities to be polite. The students were more polite to each other than I expected them to be in the cooperative learning environment; perhaps this was because I had so few opportunities to observe such politeness in the traditional learning environment. *Teachers and students have many opportunities be polite to others in a cooperative learning environment.*

Conflict resolution. Conflict resolution is a skill needed by both professors and students. Any time two or more people work together there is potential for conflict. It can be avoided by making one person the absolute authority and making all others submit, but that model is not appropriate in the classroom or in today's society. When cooperative learning is practiced in higher education, professors need to be prepared for the conflicts that might arise and how they might be resolved. *Conflict resolution is an integral part of the learning experience in a cooperative learning environment.*

Useful Models

Since teachers cannot create cooperative learning environments by exerting power and authority or by giving specific directions to their students, many aspects of cooperative learning involve modeling by the teacher. Cooperative learning is itself a model, as is writing to publish what we have learned for others to learn from. Computer models that demonstrate relationships between variables are useful models; students may be inspired to do similar creative work when they learn that another student has written the model. *These and many other models are more powerful models than teachers may realize.*

Cooperative learning as a model. Cooperative learning, where teachers are learners along with their students, is an

excellent model for students. As professors demonstrate a desire to learn more, students feel that they should do the same. Professors are models when they listen to students, work with them, respect their ideas, praise them for their good work, and learn along with the students. One of my students told me that small group discussions in which one of the students had been designated an "encourager" caused all of the students to be more encouraging to others in group work. *The level of awareness was greater than if it had been only a verbal suggestion because it had been modeled.*

Writing models. One of the most effective modeling activities professors can use in a cooperative learning environment is writing. They can write and publish in an electronic information system on a local area network in order to deliver information to their students. Many professors publish in professional journals, and writing good text files to be published with the student files serves as an excellent model for the students. The traditional term papers students write can be converted to files formatted for electronic publication, making them available for other students to read. The quality of these publications will have a great impact on the quality of the work of new students; it is hard to imagine a new group of students choosing to do lower quality work than the students before them! *Writing examples set by both teachers and students are effective models that will stimulate further writing because students want to do good work and have it used by others.*

Computer models as models. As more students acquire computer-programming skills, more creative computer models can be written and used by others. The day will never come when we can purchase software to do everything we want to do so students should learn to program (Boomer and Moen 1996, Runge and Moen 1996). Supporting computer models with text files, worksheets, images,

videos...all components of electronic publishing...contribute to an understanding of relationships that would otherwise be abstractions or verbal models only. *Computer models are not just mathematical calculators; they are symbolic processors that stimulate creative thinking in any subject on many different kinds of problems.*

ARBITRARY ASSESSMENT

What are traditional examinations? Attempts to see what students know or do not know? Are professors trying to validate the amount of knowledge their students have or the knowledge itself? It is traditional to give exams periodically throughout each semester and a final at the end. Further, courses are usually evaluated by students at the end of a semester. Such timing is arbitrary, and Perelman (1992) points out that it is *"...as obsolete as inspecting products for defects at the <u>end</u> of the assembly line."*

What professors try to learn about their students by giving exams does not always represent what students have learned. Students know that, and are quick to point out questions that are vague and ambiguous, and material that they knew that was not in the exam, *i.e.* they studied the wrong thing. Students are quick to argue over interpretations and the number of points given on essay questions. Could it be that traditional examinations, limited to a certain number of pages and questions and a set amount of time, are more arbitrary than authentic?

Students are asked to reveal what they know by responding to what the teacher asks on a traditional examination. The evaluation is controlled by the teacher, and may or may not be relevant to "real life" expectations of knowledge. Students try to match wits with the teacher, guessing what will be on a test and taking their chances.

Missing the mark for whatever reason gives students opportunities for complaint and self-pity, which they are more than happy to share with other students who have similar excuses for doing poorly.

What would happen if the situation was reversed and professors were examined by students? Professors would likely feel uncomfortable about that. We would prefer to discuss the subject matter with our students, interacting with them by sharing our thoughts. We would feel that by doing so the *students would have a much better idea of what we know and how we think than if they gave us an "exam."* Is it not likely that the same is true when professors evaluate students? Let us consider some ideas about authentic assessment rather than arbitrary assessment.

AUTHENTIC ASSESSMENT

It is traditional to have students complete assignments individually and take tests as individuals. Some professors have their students work together but require *individual* reports from each of them. Why? Perhaps because, as Perelman (1992) says, *"The role of collaboration...in learning is placed in the category of cheating."*

Even though test writing, scoring and grading is not as enjoyable as lecturing for most professors, one of the last powers professors are willing to give up is the responsibility for assessing student work. While professors are ultimately responsible for assessing student work, there are many ways for students to assume some of the responsibility, without considering it to be cheating. It is not only desirable but also natural for students to assume that responsibility in a cooperative learning environment.

Authentic assessment is based on meaningful experiences. Investing part of one's life in something, as

students do in a cooperative learning environment, makes learning more meaningful. Sharing ones knowledge and understanding with others makes learning more meaningful. *Professors owe authentic assessment to their students.*

Learning Group Assessments

Learning groups need to learn how to assess their own productivity as a whole, and students benefit from developing personal and group evaluation skills. When students assume responsibility as a group for doing their work, they also assume responsibility for the quality of their work as individuals. *Students gain confidence in their ability not only to learn but also to evaluate the value of their work when they assume that responsibility.*

Assessing group progress. Group progress needs to be and can be assessed when tangible products are expected from group work. Progress in relation to time from start to finish, the amount of time taken for different activities within a project, the status of group products such as publications for a course information system...these all can be and should be assessed by the group before being assessed by the professor. This places the primary responsibility for assessing productivity on the group of individuals responsible for the work rather than on the professor.

Who corrects what? Teachers are often reluctant to have students "correct" their own papers. Why? Suppose students are asked to complete some calculations on a take-home worksheet. Since there is no control over the source of the answers when they can work on the problems on their own, there is no point in having the teacher or a teaching assistant grade the worksheets. Asking the students to "treat it like a test" does not guarantee purity. Rather than spend hours of time outside of class correcting such worksheets for

the students, a few minutes of common time in class gives every student the correct answers and opportunities to discuss questions they might have. Telling students that the worksheet will be graded, and the grade is worth a stated fraction of their final grade, is not the learning incentive that should be promoted. Rather, worksheet and other *assignments should be prepared in such a way that learning more about the concepts and calculations is the motivation for completing the work rather than a grade.* Working in groups and assessment by groups makes such evaluation activities more efficient.

Authentic Assessment is Easier

While cooperative learning requires some adjustments in the way student work is evaluated, it is actually easier to make meaningful evaluations of student work in a cooperative setting than in the traditional one (Moen et al. 1998). Professors have more contact with students in a cooperative learning environment than in a traditional lecture setting. Each contact with a student in a cooperative learning environment is an opportunity to learn about their attitude, their knowledge and their skills. Professors also have formal evidence of their student's work in cooperative learning environments because both students and professor can evaluate real products—participation, presentations and publications—as they happen. Such authentic real-time assessment is better than end-of-the-semester assessment is, whether arbitrary or authentic. Brief descriptions of some examples of authentic assessments are given next.

- *Library, laboratory and field research by students provides professors with opportunities for meaningful discovery, discussion and evaluation of results.*
- *Published work by students provides professors with opportunities for professional-level editing of student writing.*
- *Information systems provide students with opportunities for professional-like publishing and professors with opportunities to evaluate student productivity.*
- *File folders maintained by each student provide a tangible record of progress and products of students, much like the personnel files of professionals.*
- *Performance reviews provide valuable authentic assessment similar to career evaluations, and students benefit greatly from this more personal evaluation.*

While peer evaluations can be an integral part of a cooperative learning environment, students should not be responsible for assigning grades to their peers. Teaching assistants can be helpful in determining the order of students in relation to each other for different aspects of a course but professors have the ultimate responsibility for calibrating and assigning course grades.

CONCLUDING REMARKS

Making the transition from the traditional text-lecture-test teaching method to a cooperative learning environment involves many changes in both attitude and approach. Rather than thinking of it as a move into an unknown area of nebulous learning, think of it as a move toward creating a

professional-like environment (Moen et al. 2000). Students are the career professionals, and they work together to produce information resources of value to others. The generic product is information, the functional products are knowledge and understanding, and the practical products are technical skills and problem-solving abilities. *Once the transition to cooperative learning is made, teaching and learning blend together and every day can be rewarding for both teachers and students.*

Chapter 12
Life-long Learning

Life-long learning appears to be necessary in the 21st century. There has always been so much to learn that a lifetime has never been long enough, but people could get by with learning less in the past. Previous generations could learn what was needed for their chosen career and it was sufficient for the duration of the career, with a few minor additions perhaps. Now, rapid changes in how even ordinary things are done make life-long learning a necessity. Students are preparing for personal and professional lives that will make demands on their knowledge, understanding, and problem-solving abilities that are not yet defined. *What should students be learning when facing such challenging futures?*

INTEGRATING LEARNING AND SHARING

We are already living in a world of global communications, global information access, and global interactions among governments and societies. Continuous learning will be necessary just to be participants in society; people will be forced to keep on learning.

Professors can help students acquire a desire to continue learning by providing meaningful opportunities for intellectual growth while acquiring enabling skills. When learning is intellectually stimulating and the skills that are acquired are used, the probability that students will want to keep on learning is increased. Teachers know that when students enjoy the learning opportunities and acquire meaningful skills in their courses, students do not want the

course to end. *Seamless courses do not end...the interconnected knowledge makes it difficult to set boundaries to courses.*

Professors can help students want to continue learning by giving them opportunities to share their knowledge with others. Competition among students may have to be reduced before sharing is commonplace, however. Students are less likely to share their knowledge with those whom they view as competitors rather than cooperators. How long should learning and sharing continue? *Learning and sharing ought to be rewarding life-long endeavors.*

Are there some basic premises on which life-long learning can be built? Consider these three.

- *Lead by example and learn by experience.*
- *Learn with others and from others.*
- *Learn for self-enrichment and for enriching others.*

Intellectual growth will be encouraged if these premises for life-long learning are part of the learning environment in higher education. *Learning is natural when people learn by experience, with others and from others, and are enriched by their learning.*

ARE THERE ANY BARRIERS TO LEARNING LEFT?

Theoretically, no. The human mind can learn, or try to learn, just about anything that can be conceived as learning. That's why each new generation does things that the previous generation didn't think of or couldn't imagine.

Practically, yes. Time will always be a barrier to learning, even with the most rapid information processing tools available. Students will reach limits to learning, even

in the most well designed learning environment because of time limits.

Professors should strive to give all students equal opportunities, but expecting to design a learning environment that will be "just right" for every student is not realistic. Less than 100% success is achieved in the best-designed learning environment because some students are simply not interested in a course. Teachers can not reach every student. We know, however, that an active learning environment provides more opportunities for learning than a passive one does; it is not necessary to do more research to prove that point. Rather, *research should be directed toward finding out how to design even more effective learning environments.*

Risk-taking

Working with people in any capacity always involves some risks. What is the real risk in education? The real risk is that teachers do not think broadly enough about education, communications, psychology, technology, philosophy, religion, politics, natural laws...the list of things that we risk not thinking about or understanding well enough is long.

Failure is detrimental only when people are ruled by their failures. When failure is used as steps to success, as learning points in a life-long endeavor, then mistakes can be excused because *"...mistakes are not failures but just stepping-stones toward the truth"* (Perelman 1992).

Ingredients for Learning Success

Is there a main ingredient or a particular combination of ingredients that result in learning success? As parents, my wife and I are aware of two ingredients in life that we share

with our children. Warner and Rosenberg (1976) verbalized them...*"Knowledge and love are a powerful combination."*

Does the combination of knowledge and love apply at the college level? Of course it does. Professors are expected to have detailed knowledge in their area of expertise. What good is that knowledge if they don't care about the students? The parental love we have for our children is not the same as my caring for the students, but the common thread of concern for students as people was there. That became much more meaningful to me after our four children graduated from Cornell University because, having my own children on campus made me realize how much the parents of my students might be caring about them. I have concluded that, for learners of any age, *how others care about us makes a tremendous difference in how we feel about ourselves, and that has a major impact on how much we want to learn.*

A TEACHER'S ULTIMATE GOAL

Helping students become life-long learners should be one of a teacher's ultimate goals. When a student can say *"Thank you, I have learned how to learn"* a teacher knows the goal has been met. When a teacher can say *"I am no longer necessary because my students have learned how to learn"* the ultimate goal has been met. *Let's put learning first.*

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A CONCLUDING REMARK…

The list of references cited above is short, not because there is a shortage of material pertaining to the subject of this book but because it is not a review of the literature. Thousands of references promoting active, cooperative, and experiential learning at all educational levels have been published, many of them promoting more active learning in higher education 20 or 30 years ago. The professorial community seems to be somewhat unaware of these publications, or perhaps professors are particularly reluctant to change the model. It is my hope that this book will help professors recognize the benefits of active involvement of undergraduates in their own learning and help their students become life-long learners.

Index

This index includes many entries that are phrases rather than single words. Readers should review the entire list of entries for an overview of the topics in the book.