Reflective Practitioner:
Grounding the Use of Instructional Technology in Principles, Teaching Philosophy, Course Goals and Disciplinary Values

José L. Fernández-Solís, PhD
Texas A&M University

Abstract:

Necessity, when assigned to teach a large introductory class in Construction Science, required I learn quickly the requisite instructional technology and its application. The title, "Reflective Practitioner" is an anachronism that does not capture the actual chronology: practice, finding a theory and applying it, and reflecting on the practice to find grounds for improvement. Practice was grounded in learning how to learn as the final objective of this course. In the process, objectives, goals, syllabus, assignments, projects, evaluations, lectures, and presentation techniques, had to be created.

After teaching the course two semesters, I read the following and received coaching from the Center for Teaching Excellence. This provided an opportunity to reflect on what happened, clarify the theories, examine my teaching philosophy and further clarify the principles that inform the framework for the course. This paper reports on the result of this reflection and is based on the wisdom-of-practice scholarship (Weimer, 2006) therefore experience-based and subjective.

This paper captures the flow along these major lines of t professional teaching practice, the motivation, and findings from decisions made in the process. Teaching as a dynamic process assures that there will be an evolution in time. This paper also captures the evolution of the course, the areas indicated for further research and more importantly advocates a method for teaching with instructional technology in need of verification by other institutions on its way to morph into a research scholarship with qualitative studies or quantifiable investigations of a dynamic process or a descriptive research.

Keywords:
    Learning, Philosophy, Principle, Teaching, Theory

Background

We arrived in College Station from Atlanta GA on August 13th and on the 15th. I needed to get up to speed as quickly as possible on: What are the local/institutional teaching customs, methods, testing, standards and styles of communication and instruction, among many others? But most of all what course would I teach, information about the students in the class, syllabus, books etc.

On August 18th I was entrusted with teaching COSC 253 (Construction Science) Materials and Methods I. There was no time available for prior large course planning or teaching skills development. Any planning or skill development was done concurrently with course delivery.

This course is mandatory for all first year students in the College of Architecture, which means approximately 350 students in the fall and 250 in the spring semesters. As I prepared to teach this very

large class, it became clear that the application of specific essentials in administration for teaching large classes could enhance the level of student learning. According to McKeachie (2006) "teaching skillfully may be less time consuming that teaching badly." Aware that a professor time is limited, I sought to find ways to maximize doing good, while minimizing doing damage. Personally, I was motivated to become efficient, effective and enjoy teaching students how to learn the subject so I could also have time for research, publish, serve and eventually achieve tenure.

A class management system had to be quickly found that minimized administration and maximized communications so that everyone had the latest word on class or assuagements, deadlines, quizzes and exams and the many challenging day to day activities but for a very large class; a system that could operate as information and communications central 24/7. When during the final exam the entire college system was overloaded and more than one hundred students were kicked out in the middle of their examination, information and communication central proved itself, helped calm the students, and re-set their entire examination without a hitch. This event is reflected in the student's comments during the course evaluation but did not detract from giving the process a resounding approval.

This paper is based on the two types of literature found in the field of teaching by Weimer (2006): On wisdom-of-practice scholarship it includes personal accounts of change; recommended-practice reports; recommended-content reports and personal narratives; on empirical research scholarship on teaching it includes: quantitative investigations, qualitative studies and descriptive research. From the above divisions, it appears that this paper falls under the category of recommended-practice report.

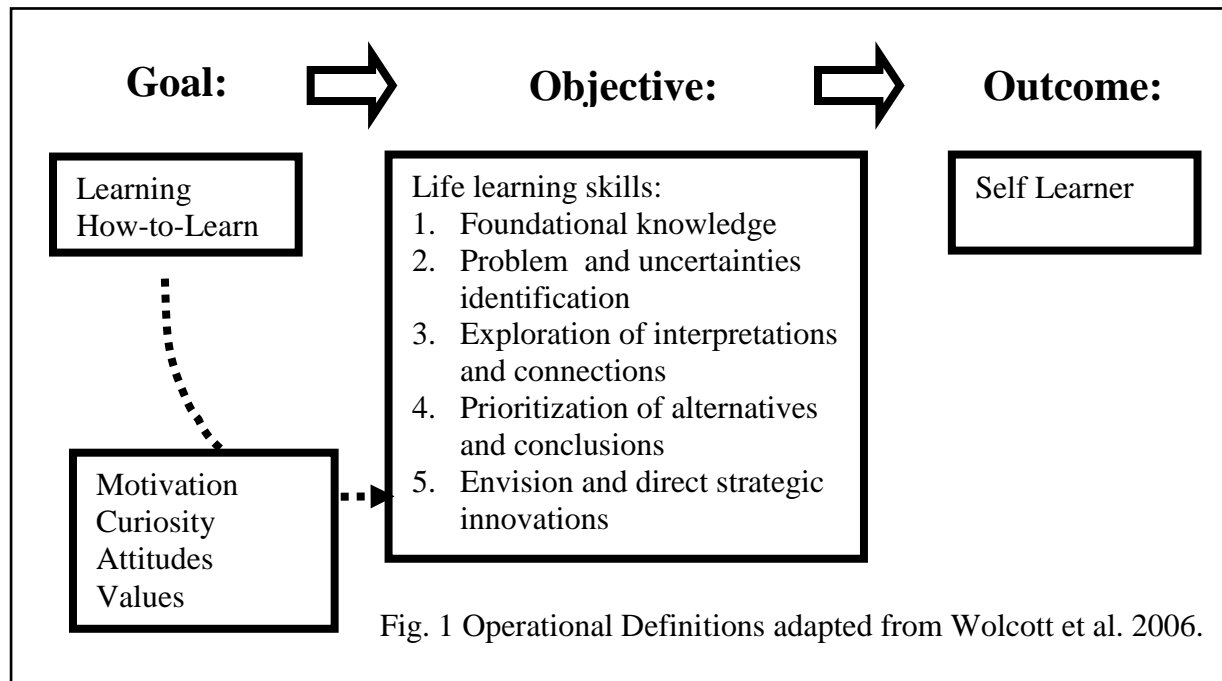The reflective practitioner title is derived from Schön's work, *Educating the Reflective Practitioner,* 1995:

> "We should think about practice as a setting not only for the application of knowledge but for its generation. We should ask not only how practitioners can better apply the results of academic research, but what kinks of knowing are already embedded in competent practice."

This paper purports to be more than anecdotal success story, but a work that embraces discipline, inclusive scholarship that recognizes that "knowledge is acquired through research, synthesis, practice and teaching, paraphrasing the words of Ernie Boyer from a decade ago. The major drawback of this paper is the lack of sustained experience. Usually more than two years teaching a course is required for papers proposing pedagogical advice. I refrain then from claiming to give advice but this early edition is to capture what has taken place and solicit other practitioners that find this paper informative, the method attractive and are in similar teaching conditions to replicate the process and compare the findings.

General Principle

Graphically, picture the shift from a teacher as a talking textbook to that of a sign pointing to where and how you can find relevant information, what you can do with it and why it is important. After all, we learn if we are extrinsically and intrinsically motivated to learn (Hofer et al. 1998). In general, I view the classroom as an opportunity for teaching a student how to eventually achieve freedom from the educational institutional system so that a student can continue learning anything that he or she finds relevant, interesting or necessary in life. This is a carry over in from my architectural practice where after mastering a level of knowledge, my role was that of finding someone to take my place so that I could find a new challenge in learning. Teaching large classes requires a mind set that takes into account how students learn, how to be efficient with administrative work and organization, see Fig. 1

along the way of learning how to take responsibility for one's learning (also referred to as self-monitored or self-motivated).

Goal: ⇒ **Objective:** ⇒ **Outcome:**

Learning How-to-Learn

Life learning skills:
1. Foundational knowledge
2. Problem and uncertainties identification
3. Exploration of interpretations and connections
4. Prioritization of alternatives and conclusions
5. Envision and direct strategic innovations

Self Learner

Motivation
Curiosity
Attitudes
Values

Fig. 1 Operational Definitions adapted from Wolcott et al. 2006.

Mind set

Before classes began, the department had scheduled a retreat where they invited the Center for Teaching Excellence (CTE) to conduct a Departmental Academy for Teaching. The Academy covered subjects like learning and teaching objectives, goals and the elements of a syllabus. However the most important item was the question: What do we really teach? My previous teaching experience led me to conclude that although we give samples of what is important in a field of study or a profession, we are really teaching the students how to learn. I remember in the 1970's professor Smith, from GA Tech COA, stating that most architects will end up doing something else in life but what they learned in school was "how to learn whatever a person becomes interested in," a simple guiding principle.

The issue is not in the details of information transfer but in the process of learning how to learn, discern what is important, where to find and how to filter the information and learn how to think. Teachers in this sense serve as pointers, human arrows pointing at knowledge building blocks that academia and the profession has determined to be relevant. This is how we supplant magic (Fraiberg 1996) with science; things that are because they are put in words as if by magic, and the facts and logic that underlie an argument, albeit heuristic. McKeachie (2006) succinctly describes the transition as it takes place in a classroom in six pointers:
1. What is important is learning, not teaching
2. Teachers can occasionally be wrong
3. Classes are unpredictable
4. Major goal: continue learning after leaving college
5. Learning mostly occurs outside the classroom
6. Reflect on what your students need to accomplish to learn how-to-learn

How do we translate this mind set in a classroom with 350 students, when a typical class is of 35 students! Besides the class had freshmen, sophomores, juniors and even seniors, came from different

disciplines such as ENDS (Environmental Design – Architecture) COSC (Construction Science – building construction), LAND (Landscape and Urban Planning) and GENS or general studies as well as from all other disciplines from the TAMU campus!

Lectures are related to student listening, reading along with listening are passive ways of learning and discussions are considered the most effective way of learning **source (year),** see Fig. 2. The ideal situation appears to be if the entire class or sub-groups is able to discuss a subject at their own time. The guiding principle is that interactions that facilitate learning need not be limited to those with teachers.

Fig. 2. Gradations of Learning Modes (Adapted from McKeachie and Svinicki (2006)
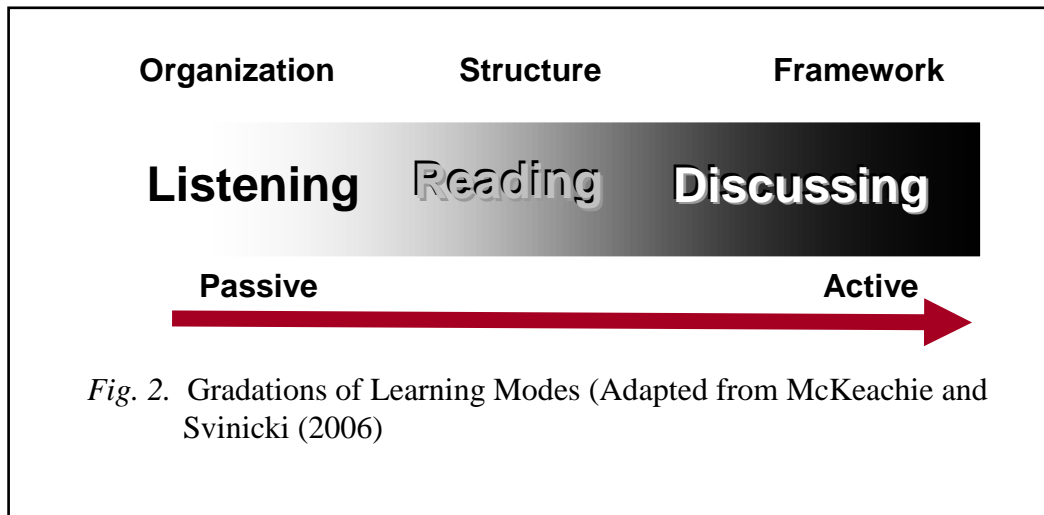
Tools of the Trade

Teaching has two major components: Administration and teaching. Very large classes, if done with the same type of administrative tasks (including preparation, assessment, evaluation and handling grading and other issues among others) as small classes will consume an inordinate amount of time. Teaching (including student individual attention by the professor, motivation and counseling as well as lectures) a very large class also requires inordinate amount of time.

Early on I decided on maximizing student interaction and minimizing administration. The one Teaching Assistant and I enrolled in every course that the Instructional Technology Service (ITS) had to offer for managing classroom instruction using Web/CT Vista (Blackboard) version 3 (but now migrated to version 4) such as:
- Smart Technologies Workshop
- Clickers Workshop
- Blogs and Wikis Workshop
- Vista 4 new users' workshop
- Vista 4 Migrating User Workshop
- Vista 4 Assessment Workshop
- Vista 4 Assignment/Rubrics Workshop
- Vista 4 Communication Tools Workshop

On teaching, besides the on going departmental Academy, I enrolled in programs from the Center for Teaching Excellence such as:

- Inquiry Based Learning Workshop
- Introduction to the Teaching Portfolio
- Enhancing Critical Thinking Skills by Susan K. Wolcott
- Teaching with Blogs and Wikis
- Developing Students' Critical Thinking Skills by Susan K. Wolcott
- Early Feedback Program 2006 and 2007 (consultant observation, student assessment and a review meeting with the consultant)
- Semester-Long Grant Writing Workshop
- Course Development II: Assessment and Feedback that Demonstrates Student Learning
- Course Development I: Beginning With the End in Mind
- Teaching Large Classes Faculty Learning Community
- Teaching Academy, 2007
  - Writing Effective Learning Outcomes
  - Improving a Course Syllabus
  - Inquiry Based Learning
  - What Best College Teachers Do
  - Developing Student Capabilities
  - Assessment
  - Active Cooperative Learning
  - Project-Based Inquiry Guided Learning
  - Course/Curriculum Design
  - Peer Evaluation and Development Teaching

Based on what I learned and did in the classrooms I was asked to share with other faculty the following: *"What I have learned in Using Vista 4 for a class with 329 students"* at the 3rd Annual Teaching with Technology Conference; and *"Using Technology in the Classroom,"* at the Wakonse South 2006 Conference sponsored by CTE of TAMU. These presentations helped articulate the work in progress and receive feedback from colleagues.

Fortunately TAMU, a large and busy university, does not have the impersonal attention that largeness connotes. ITS and CTE provided individual attention and service in helping me learn how to teach and became models for me to provide in a large setting the individual attention and service to the students that are learning how to learn. For example, when I brought to CTE attention that there were no programs geared to helping teachers learn and share tips and lessons learned on large class environment, CTE created a Faculty Learning Community that practiced "learning how to learn by group sharing with guidance" another excellent model for walking the talk.

I quickly settled for Web/CT Vista 3 and on the second semester migrated to Vista 4 which is now a Blackboard instructional technology tool. Of the many features for course management system the most used ones are in alphabetical order:
- Announcements (which pop-up when students log in)
- Assessments
- Assignments
- Calendar
- Discussions
- Grade Book
- Mail
- Resources

- Roster
- Syllabus
- Who is on Line

Thoughts on How to Assess Large Classes

Assessment of learning and evaluations are a major component of a course administration and sometimes the learning aspects of teaching. For this course I chose to investigate how assessment could become more of a learning tool. In general, it can be said that students would like assessments to require reasonable effort and be interesting (Harter, 1978). From my perspective I was looking for ways to assist students to achieve mastery (demonstrated by a desire to know) rather than performers (demonstrated by a desire to impress). An acute differential test of this would be that students interested in mastery find mistakes as opportunities while students interested in performance view them as character flaws. Covington (1999) calls them extrinsically (external reward) or intrinsically (self reward) type of motivations.

Class set up

The class covered twelve chapters and originally I decided to assess two chapters with a quiz and then the same first two chapters plus the next two chapters by an Exam. Since then I have morphed the system to test every two chapters with a quiz and four chapters with an exam and the entire course with a comprehensive exam, making the progress semi-cumulative. Literature recommends assessing often when using it as a tool for learning; see Fig. 3.

Fig. 3 Assessment Program
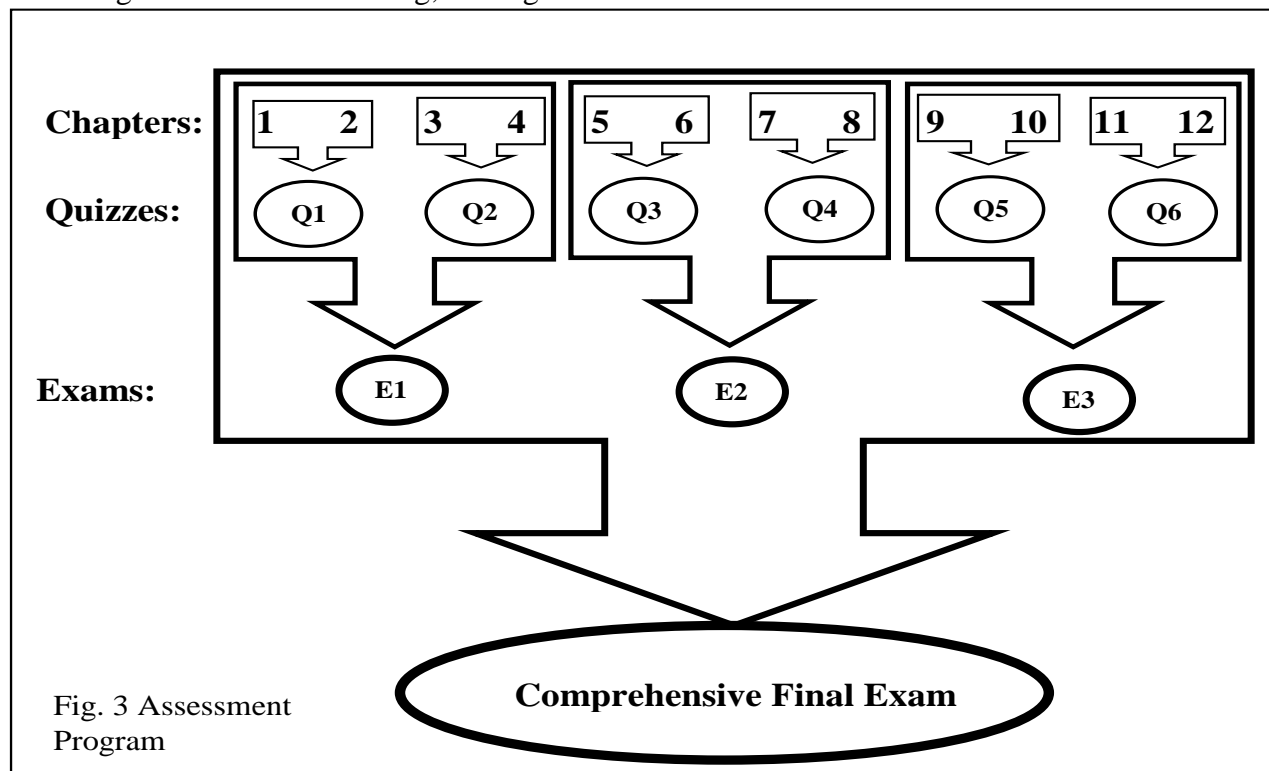
The assessment process and how to study for it were addressed in the syllabus as well as in the introductory class presentations. Later on, 'how to study' was repeated before a quiz or an exam and further reiterated during personal student and class evaluation reviews. However the assessment were done in Web/CT Vista, a new tool for most freshmen and even for other students and that initially created anxiety that needed to be addressed.

Learning is both an individual and a social endeavor (Patrick et al. 1997; Wentzel & Wigfield 1998). The bonds with other students and the professor form a social support system that enhances student motivation, class attendance and participation. Web CT allows each student to post a picture on the class roster thus making it easier for students and the professor to learn the names and form groups with those that they have met in class, see Fig. 4.

Insert Fig. 4 Author contact information and photo

Mitigating Assessment Anxiety

Assessments are about how each student is learning how to learn the essence, the building blocks of the profession, materials and methods. This is a point repeated before and after each evaluation as well as during individual student performance review. Progress in the process of learning is more important that grade progress, although the score is an indication of performance at a moment in time. Anxiety is an issue that I treat holistic. It starts with the first day of class and in every class.

Academic success has multiple elements that influence the final evaluation and students can control with their choices and actions: Choose to attend class regularly, participate constructively; persist when learning is difficult; devote time and effort in preparing for class and completing assignments according to requirements and on time (responsible and responsive), take time to review their individual progress with the professor and seek help when needed. Although a grade can not be attributed to each of the above elements, holistically they are the elements that influence a top grade. Diminish any item and the resulting academic success is affected proportionally.

In order to minimize anxiety, I arrived before class started and after setting up, made conversation with the students that arrived early. After class, I was able available while shutting systems down to answer specific questions and receive verbal comments about the presentation. Regarding assessments, a non graded practice quiz on the syllabus was given during the first week of class. This quiz provided guidance on navigating electronic evaluation and gave me a general view of how the students understand the class contract (the syllabus) and what areas need further emphasizing. It also allows them control and choice in when and how to take the quiz (Hofer et al. 1998). The format allows students to decide within a published window the date, time and location. For example a quiz window typically opens Wednesday at 10 am and closes Friday at 4 pm for a 10 question quiz (five true/false (T/F) and five multiple choice (Mc)) with an ample 20 minute duration.

Furthermore, during the second week I gave a fixed bonus point on the last semester comprehensive final exam (CFE). For this bonus exam, I asked the students no to study, no books, no notes, just become exposed at taking an exam with WebCT/Vista/Blackboard and become exposed to the types of questions that they will be encountering in an exam.

Taking an exam with WebCT/Vista/Blackboard at their own pace, at their own place on a date of their choosing is a way of transferring control and choice to the students (Lepper & Hodell 1989)on what they consider most important, learning and its grade outcome. Exam have a different window, they open up on Friday at 10 am and closes the following Monday at 4 pm. This takes out most excuses of class interference, allows those that like to take it at the end of the week or at the beginning a choice as well as those that prefer leisure time such as Saturday or Sunday. If there is a conflict on one day, well there is another. Even so, I experienced a number of excuses that tested the edge of the envelope of believability.

The database of chapter questions initially had a minimum of 20 T/F and 10 MC and they were going to see an exam from a computer randomized 5 T/F and 5 MC questions per each of the 12 chapters. Their score would not matter since taking the entire CFE would earn them the 25 bonus points thus taking the pressure out of performance. This effort has also placated those students that felt that because they have worked in construction, they know the subject matter and those students that have a preconceived notion that the class subject matter is easy and do not need to study. In one case where the student was adamant that he knew the subject and would make an A in the course, I offered to give the grade of that he made on the optional bonus CFE. After a dismal 65% the student buckled down to learn the subject of the course.

Moreover, this optional bonus CFE creates a baseline of knowledge that each student brings to the class, an item that became significant later on as will be explained.

Assessment Set-up

If the students are to take an exam within a window where they can choose the day, time and place, how do you control cheating? Cheating is a major concern of any institution that is primarily focused on testing. If assessments are viewed as a method of learning, the cheating takes another perspective. In my syllabus, under the honor code which is the first question on any test or exam that the student has to answer, the second question is what is the student UIN or identification number, quizzes are to be taken alone and exams can be taken individually, with another or a group. As a matter of fact the third question of an exam is: Are you taking this exam: alone, with another, with two others, with three others or with more than three. The syllabus states under the honor code that the quizzes are to be taken individually and the exam may be taken individually or in a group. Exams with an option to take them as a group are a form of cooperative or learning cell when viewed not from a purely evaluation point of view but from a broader perspective as another opportunity for learning (Miller and Groccia 1997; Sokolove 2000, Goldschmid 1971). Did cooperative exam option improve the grades of those that chose it? This is item is discussed later on.

The students answer to the question on how they are taking the exam with no self-incrimination. This has been a great tool to assess if alone or in group affect the score bias. Very interesting results have come from this experiment. A good number of students after taking the first exam in a group realize that they are having to take the exam multiple times, the help from other students is little or not reliable (some even mention that they would have answered a question differently but were persuaded) and revert to taking the remaining exams alone. This leaves those that are not in the top of the class helping one another, however when you compare the grades a student make in a quiz (alone) and in an exam (possibly with others) there is not significant different. Why?

The database of questions is composed of several layers. Take the questions for any one chapter: There are questions that previous classes saw, questions that the students created and perhaps were morphed by the professor (from a low –level question to a higher –level question per Wilhite 1983) and questions that the professor added based on items covered in class but not in the text. Besides, any question that previously was found to be ambiguous and provided acceptable justification by those taking that question and received partial or full credit and the question was deleted from the database. Perhaps the large database of relevant questions and the fact that the computer randomizes each test question to mitigate the possibility of any group of students seeing the same test is a contributor to the quiz and exam grades.

However, the most important concept behind this set up is that the students are motivated to read the assignment and make up questions for a database that they are able to see through WebCT/Vista/

Blackboard Discussion section for each chapter, giving them the heads up of what all other students have also found interesting and important, plus the professor's comments on the posted questions. This builds their confidence in learning what is important to learn. According to King (1990) the principle behind this is that "training students to generate thought-provoking questions enhances learning." This approach in students generating questions goes beyond the think-pare-share of Pressley et al. 1992.

The class becomes one big study group with sub-groups discussing the class material, in a total learning program, see Fig. 5.

Fig. 5. Total Learning Program
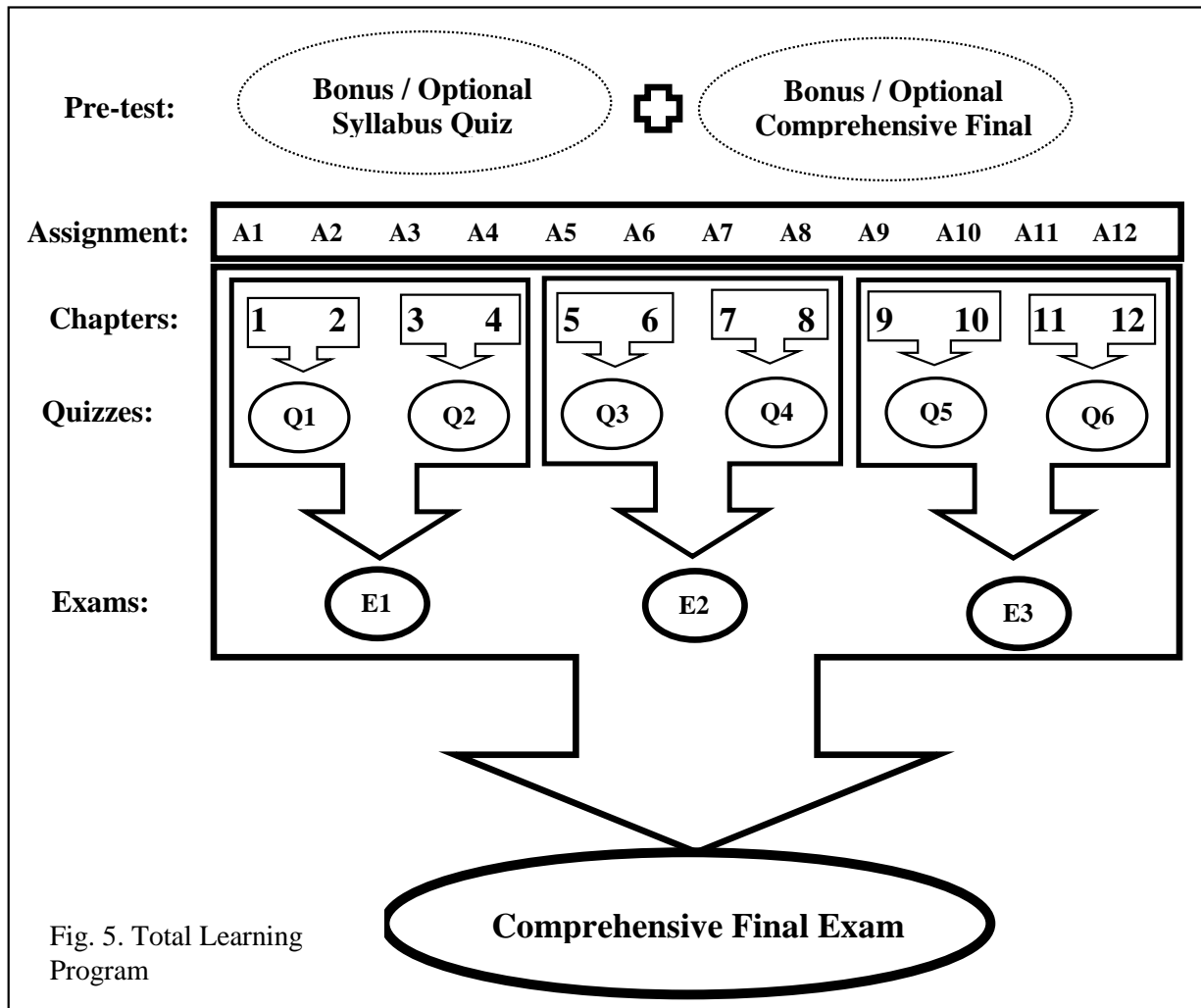
Students with disability have 1.5 or 2.0 the time of other students but Web/CT Vista tracks the amount of time each student takes per question and total time spent on the evaluation and thus far a minority takes the entire time. As a matter of fact, early on, the first semester of teaching in 06, the TA set up the time to be 30 hours instead of 30 minutes for a quiz. One student took 6 hours and made a 60%. After checking with CTE, we came to the conclusion that the pressure of time could be minimized by doubling the amount of time for quizzes and exams. Since then, there has been no complaints on time and most student finish it within the original 30 minutes.

The Comprehensive final exam at the end of the semester is now an optional exam that they can take in group or individually, open book and notes with an ample window and sufficient time so that it is not a constraint. This takes away the pressure of the student in taking the exam, however if they score higher than a previous exam. For those that have missed a quiz or an exam, even though there is an ample

window and they could possibly log in and take the exam from any computer in the world, the final exam option is the only make up possibility.

Notice the standard deviation among quizzes and among exams, they are right on acceptable values. The difference between the standard deviation in quizzes with those of the exams is also within acceptable tolerances. The final grade has an even lower standard deviation. In the final end, what will the students remember a week or a year after the course is more likely gauged by the pre-test comprehensive final exam serving as a benchmark of what the students knew coming into the course and the Optional Comprehensive Final Exam which supposedly was done under minimal performance pressure, except for those that had missed a quiz or an exam.

In general, prevention of cheating is preferable to punishment. A view of assessments as an opportunity for learning, a moment in time when learning is focused at both an individual and collaborative level was essential to a progressive taking away the reasons for cheating: First by making resources available to the students on a time sensitive assessment. Second, when a quiz window was set up for 30 hours and only two out of more than 200 students took more than one hour and the student that took six hours scored merely 60% time sensitivity was taken out of the equation. Time had been a source of student anxiety, and I was glad to remove that impediment. The last taboo of cheating is taking the exam with the advice of others. Reluctantly, at the advice of CTE and by their encouragement to see exams as learning opportunity, collaborative exam were made an option. I have been surprised that the best students have declined this option and find that the grades of quizzes and exams per students maintain a correlation even when the two are taken under different formats. This is definitely a point that merits further experimentation.
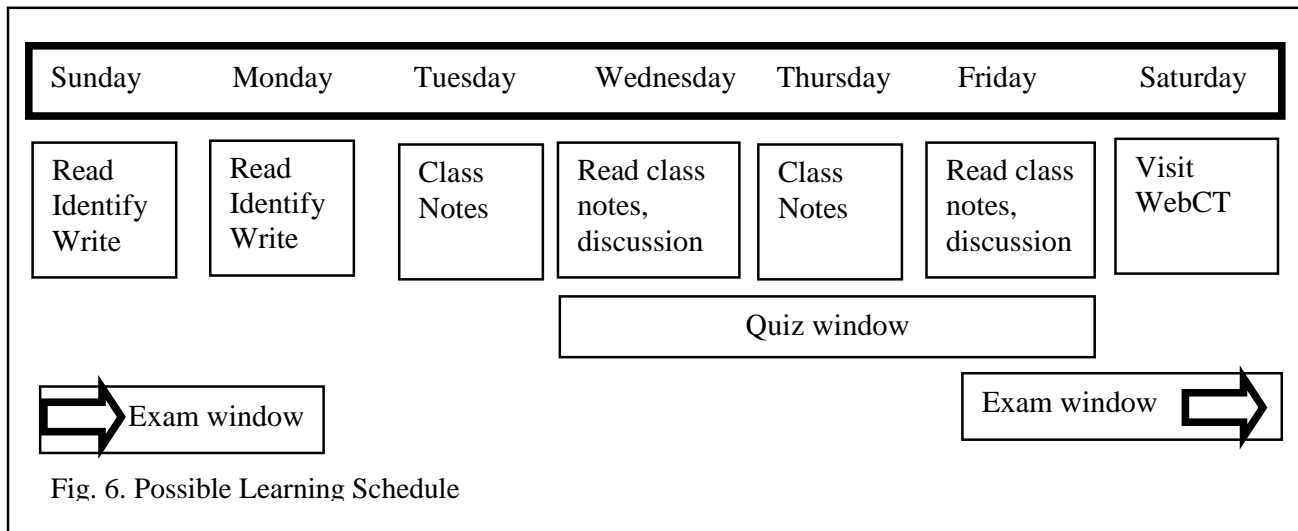
Assessments are part of past performance on a subject that mostly are relegated to memory but, at least in the near future like when applying for a job or graduate studies, are part of indicators of future performance. This past performance takes place in a classroom context by an individual, future performance will take place as part of a professional group by individuals. Logic indicates that performance then has two components individual and collective or collaborative (Lin et al. 2003). The two forms of testing, individual and collaborative when added together may end up as a better measuring field regarding validity and reliability at a macro level: Validity in that it measures both individual and collaborative effort; Reliability in that both the individual and the collaborative evaluation are within a reasonable range of each other across time and multiple students. This is an interesting fact that merits further argumentation.

Internal validity and reliability of each assessment is based on the following: Validity of the quiz and exam as an instrument to test the first block of knowledge in Blooms' taxonomy through the use of True or False and Multiple Choice questions is accepted by the literature searched. In other words it measures what it says it measures, basic knowledge, definitions, first building blocks of knowledge, concepts and deeper thinking of the attributes, criteria and historic evolution of materials and methods in construction. The format appears to be reliable across a limited amount of time although it has not been used by multiple graders at this point in time. One of the reasons for the details in this paper is to entice faculty in other universities teaching this basic course in large class settings to learn and use this format to help validate the findings.

Assessment Questions
Students prepare the T/F and MC questions on their assignment reading either on Saturday, Sunday or Monday and turn in a typed paper version on the Tuesday class along with a statement of why they

found the question interesting, what peaked their curiosity, what else they would like to know about the subject, any further reading or research that they may have done on the subject matter (see Fig. 6).

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Read Identify Write	Read Identify Write	Class Notes	Read class notes, discussion	Class Notes	Read class notes, discussion	Visit WebCT

| | | | Quiz window | | |

Exam window →   ← Exam window →

Fig. 6. Possible Learning Schedule

The students are encouraged to use the Power Point (PPT) of each chapter that is available in WebCT/Vista/Blackboard as an outline and they should review them before reading the book. The possible learning schedule is based on a 3 credit hour course, with 9 hours of class preparation for a total of a minimum of approximately 12 hours of work weekly. Informally, with students' conversations, there is no direct correlation between study hours and grades since most bright students study and take the evaluations alone with a reported relative low number of hours.

The answer needs to also contain the page number where the information can be referenced in the book or note if it is a statement made in class. An assignment counts for 10 points each, however handing in a hard copy earns them 5 points, the other 5 points are earned when they post the questions on WebCT/Vista/Blackboard, discussion folder, on the corresponding chapter for the class to see. The TA handles the administration of turning in the paper and posting the electronic version.

The hard copy typed version along with any other item that was noted in class presentation such as question for discussion or brief statement must be turned in at the end of class. The typed requirement means that the question must have been created before class. No typed, no credit and also no credit for lateness.

The posting of the electronic version allows all the students to see what other consider important from the readings in the book or in class presentations but also the professor comments (see Fig. 7). If a question merits and excellent, the students know that the question or a morphed version will be part of the chapter database of questions. If the question merits a good, it is not. Sometimes a student will be asked to elaborate, add information that is missing or re-word the question for consideration. The discussion board of WebCT/Vista/Blackboard belongs to the whole class and takes place off-class, actualizing the statement that most learning takes place outside a classroom context.

From conversation with students, those that take the quizzes and exams alone also prefer to study alone and usually are the top students. Others that study and take the exam evaluation in group have reported that group discussions are beneficiary; however there is a limit to the size of the group that they find efficient. Students select their own partners.

		chapter 1 Q/A ⌇		
		(72 Messages)		
		Place here Chapter 1 True or False and the Multiple choice questions, answers and your comments.		
☑		**Multiple Choice** ⌇ **(New)**	Ryan Frederick Aldrich ⌇	May 4, 2007 2:02 PM
☐		**T/F** ⌇ **(New)**	Ryan Frederick Aldrich ⌇	May 4, 2007 1:59 PM

Message

Subject:
Multiple   **Topic:** chapter 1 Q/A
Choice

Author:
Ryan
Frederick   **Date:** May 4, 2007 2:02 PM
Aldrich ⌇

The standard outline used for organizing information about construction materials and components.
A).Construction Specifications Canada (CSC)
B).Access Standards
C).Sustainability
D).MasterFormat

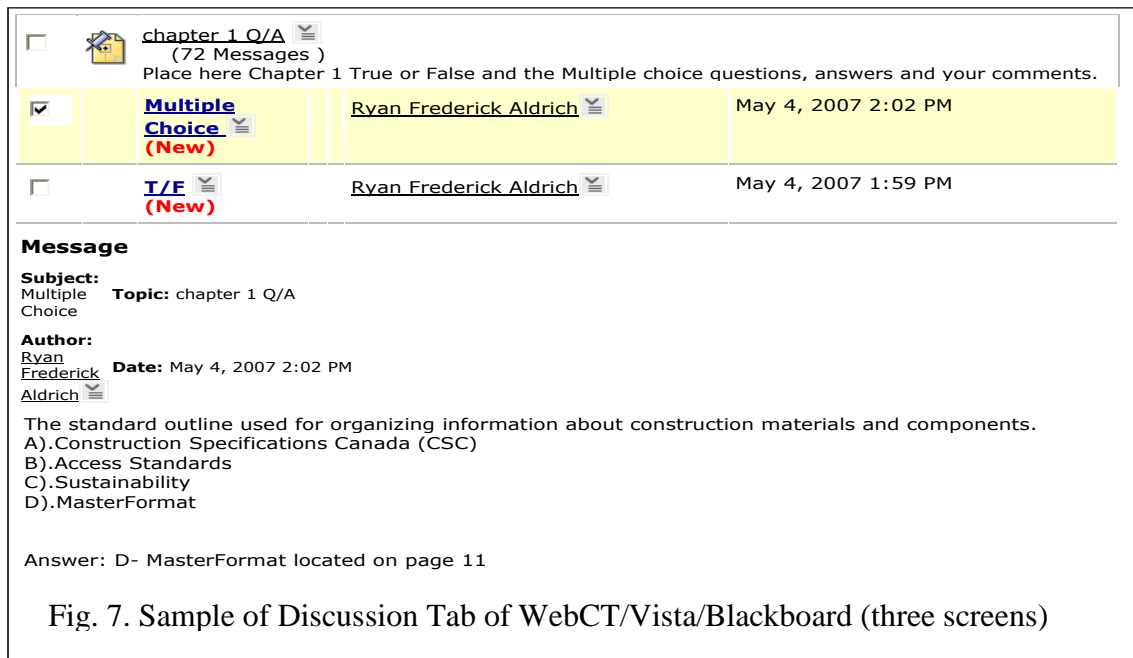Answer: D- MasterFormat located on page 11

Fig. 7. Sample of Discussion Tab of WebCT/Vista/Blackboard (three screens)

Generally students are encouraged to see how a question may be worded differently or information presented in a questioning form and with practice, their questions are neither too easy, giving away the solution nor too hard, out of a context that is recondite and would not test knowledge. However all questions require careful review by the professor, a linguistic editor, and a final review with the overall mosaic of questions in the database to see if a picture of knowledge and learning is somehow discernible. In other words, the assignment of writing a minimum of two questions per chapter, one T/F and one MC per student (realize that when the class is of 200 or 300 plus students there is a considerable number of questions generated) accomplishes the following:

- The whole class as a discussion group as well as possible sub-groups of study
- Discussion and thinking on how an item of learning can be posed as a type of question with the goal of getting it included in the database (student advantage)
- Discussion on how a question can be morphed and how it could re-appear as a higher-level question (this requires students to think about the material mostly through discussions, Whilite 1983) per the following examples:
  - (MC) how would you apply the concept of _____ in a construction site?
  - (MC) The limited capacity of _____ affects all of the following EXCEPT?
  - (MC) Researchers of metals and researchers in applications approach the use of _____ differently mainly because of :
  - (MC) examines the validity of an argument and determines which the weakest link is.
  - (TF) Compare one theory with another
  - (TF) The following are important dimensions (points, criteria, characteristics, attributes) in a comparison
  - (TF) Evaluate, compare or judge the relative values of a _____ in an argument.

The objectives are:
1. Present the students multiple opportunities to practice and to see other students practice what is meant by the concept of active learning, self-learning, learning how to learn
2. Provide ample samples of how to become self-learners by using bricks and mortar, nails and other common materials and processes as a tool

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3. Model why it is important that they become self learners through lessons learned case studies and the rationale (deeper thinking) behind common things and processes.
4. Showcase how to evaluate the evidence behind a product or a manufacturing process mostly using a historical perspective. In other words how to search for and analyze the rationale underlying what we do in construction. For example (based on Maier 1952 and Bloom's 1956 Taxonomy):
   a. Clarification of a problem
      i. What do we know?
      ii. What data is relevant?
   b. What are the characteristics of an acceptable solution?
   c. What are possible solutions?
   d. Evaluate these possible solutions against the criteria of the characteristics of an acceptable solution.

Evaluations - Quizzes

Students are informed that the quizzes will be in an increasing level of difficulty and should not become complacent if they find the first one easy. The second will be medium level of difficulty and the third one will be difficult in comparison with the first one. In practice the record shows a reversal from expectations! Although the first quiz is the easiest, students are apprehensive and usually nervous in taking the first quiz, even after the syllabus and the pre-exam practices. They are not familiar with the system and the types of questions and it take a quiz to bring home the reality of an evaluation on how they are learning.

Further quizzes have more comprehensive and complex information and test their increased ability to process information and their improved thinking skills but experience shows that students have learned how to study, process the information, create meaningful questions, directly in groups or indirectly through WebCT/Vista/Blackboard discuss other questions. In other words, they have become proficient in learning at this basic level in Blooms' taxonomy (acquisition of factual knowledge and development of basic comprehension) with some forage into higher level learning skills (such as analysis, synthesis and evaluation).

During the first class session, and again at least once a month and after each quiz and exam I invite the students to come to my office so that we get to know each other. Approximately 70% will end up taking this offering. In the meeting, we spend approximately 30 minutes, in a class of 350 it comes to approximately 130 hours. We discuss where they come from, how they performed in H.S., what or who influenced their current career path, what experience they have in the filed, how they are doing in other classes, what are their study habits and which class they find the most difficult, have they found a person or group to study with, if not why, if they have how is it going and any feedback on what factors facilitate or have interfered with learning. This process requires individual attention but it is where I wanted to put my time and effort and it has paid off handsomely as discussed in course evaluation and feedback.

During the meeting with the students we discuss the individual performance in the assessments and obviously the question of ambiguity in questions comes up. Regarding ambiguous questions in the quiz or exam, we discuss them show how the rest of the class that took that specific question did, the merits of the question and what knowledge is being assessed and if the question is found ambiguous, it is deleted and everyone that took it is given credit. However non ambiguous questions are not discounted or eliminated from the data-base, no matter how difficult those that took the question found it, ergo very few 100%!

The class performance on a quiz gives a reasonable indication of a question level of difficulty as found by those students that were exposed to the question. Comparing how a student did with the rest of the class on a specific question is tempered by the relative level of difficulty of the question, an important factor when discussing student grade attribution. Attribution on the part of the student has three characteristics according to XXXXX, 1999: locus (internal or external); stability (stable or unstable); and responsibility (controllable or uncontrollable). The best situation is when a student identifies the lack of performance to be external, unstable and controllable. For example: Due to not studying sufficiently, a situation that can be remedied by applying more time and effort (possibly studying with a group, reviewing posted questions on WebCT/Vista/Blackboard, etc) thus one that the student has a choice and can control.

Evaluations - Exams

Exams have the same format as the quizzes but cover more information. The difference here is taking it as a group. The underlying reason is to make this primarily a learning event and secondarily an assessment as a motivator. The students have already seen the material in a quiz and what they have missed, this is an opportunity to revisit the material a little deeper and think about the learning at hand.

Students are encouraged to come and visit with me after an exam, just like after a quiz. However, after an exam approximately 50% of the students avail themselves of this opportunity to check their performance, or did not do as well as they had hoped, are concerned in gaps in the areas of knowledge, review of how they prepared for the exam and how did the group affected the personal evaluation. This is another opportunity to care, motivate and encourage learning.
o Have you missed any classes?
o What is your study program?
o Do you take notes in class?
o Do you have a study group?
o Did you take the exam alone or in a group? How did that affect your evaluation?
o Did you have enough time to complete the exam?
o How did you go about answering the easy and difficult questions?
o What are you going to do differently next time?

Evaluations – Optional Final Comprehensive Exams

This final comprehensive exam brings an inordinate anxiety in the student which is dissipated when it is made optional. Approximately 21% take the Optional Final Comprehensive Exam. 52% of those were able to improve their grades, 10% already had an A and more likely took it just to see how they did in relation to their own benchmark at the beginning of the course and 38% took it and most likely did not have a missing quiz or exam, and did not improved their grades, see Table 1.

Table 1. COSC 253 Spring 2007 Class Statistics	Actual Grade	Percentage
Final Grade/Total number of students	228	100%
A	78	34%
B	115	50%
C	27	12%
D/F or dropped	9	4%
Final Comprehensive Exam Option	48 out of 228	21% of total =100%
Improved grades	25	52%
Had an A thus no grade change	5	10%
Did not improve grade	18	38%

Evaluations – Final Grade

The assessment that best agrees with the question what the student will remember in a week, a month, a year's time is the delta between what they knew when arriving in class and what they took with them as manifested in the Optional Final Comprehensive Exam.

However since the quizzes and the exams were crafted with the first intent of being tools for learning and secondarily assessment, it can be inferred that the final grade is a representation of first of the learning and secondarily an evaluation of each student with self and with the class. With the class in two aspects, one the class as a whole identified to some extent the questions or areas of interest and crafted the questions and the class as a whole determined the questions that when placed in the context of an evaluation to be ambiguous. The opportunity to take an evaluation as a group can also be construed as a benchmark of the class or sub group against which a student contributes and also is contrasted (see Table 2).

Table 2.	COSC	253	Spring	2007	(Sample)			Pre-test		
								Opt. Comp. Final	Optional Comp. Final	
Final Grade 100	Quiz #1 100	Quiz #2 100	Quiz #3 100	Exam #1 200	Exam #2 200	Exam #3 200	Syllabus Quiz 10	Exam 120	Exam 120	**Evaluation Point basis**
83.7	79.1	80.6	83.8	160.1	170.6	158.0	7.6	58.7	85.8	**Average**
83.7	79.1	80.6	83.8	80.5	85.3	79.0	76	48.9	71.4	**Average %**
8.6	10.5	11.2	10.2	17.3	16.6	18.8	1.5	8.8	12.3	**Standard Deviation**
										True or False /Multiple
	24/16	20/20	20/20	20/20	20/20	20/20	5/5	60/60	60/60	**Choice**

The professor questions based on class presentations that augment the course content appear to be the principal differentiator when reviewing with students the questions that they have missed. If someone in the group was not present in class to capture what was being discussed, there is a gap in the knowledge that the group or individual can not surmount.

Course Evaluation and Feedback

Table 3 is a comparison of the final course evaluation with the department. The course was also observed by the CTE and a critique made in reference to the movement of 'reformed teaching.' The majority of students scoring the highest grade have taken the course individually. However the ones that have formed a group have through discussion and the interface with each other learned how to learn as well. Most of the failing grades in Appendix 1 are from students that dropped out of the course for various reasons, but the system carried their presence until the end and had to be accounted for with a grade.

Table 3. Student Evaluation COSC Dept. average and Dr. Author average

Year 2006	Spring	Summer	Fall
COSC Dept Average	4.142	4.386	4.265
Dr. Author' Average	N/A	N/A	4.36

Both courses were evaluated at the start of the semester and at the end (see Appendix 1 for more details): The following are representative comments from the students on the subjects of course anxiety, taking the evaluations on line and the professor performance both at the start of the course and at the end.

Early Feedback (score 3.89) (**Spelling corrected**)
- Positive aspects:
  - The material is taught in an extremely effective manner. The student is expected to learn the basics from the readings, but Prof. Author has made it clear that we are able to ask him questions if we are unsure of even the slightest piece of information. His lectures also help to clear up any confusing portions that the book may not cover as thoroughly as the students hope.
  - He thoroughly tests us on the material of the class. This helps us to really get to know this material which is important to our majors.
  - Prof. Author makes himself available to us so if we ever need help he is there. He takes time to explain things to us in his own words not just straight from the book.
- Least effective aspects:
  - There is a TON of information in the chapters and I don't know because we haven't taken the first test yet, but I am scared. I feel that it is necessary for you to talk about all the information that will be on the test in class or at least have it on the power point. I think a more fast paced and thorough review would be best on the class time before the exam.
  - On the first quiz there were two questions that were misleading.
  - No complaints really, just that WebCT is not the most reliable site.

End of the Semester (score 4.36) (**Spelling corrections**)
- Positive aspects:

- o Although I found this class very boring, I thought Professor Author did an excellent job because of his thorough knowledge from his experience, his cheery attitude, and his high expectations of us as students, and his overall passion for teaching and importance of learning.
  - o The most effective aspect of this course I think is the online Exams. This is because you can take it when you feel confident about the subject matter.
  - o I really enjoyed the online exams and quizzes. I also enjoyed how the professor used WebCT for updates and other things. It was a convenient way to find answers to questions.
  - o Professor Author was an excellent teacher! The exams were a little difficult, but I would definitely take another class one of courses.
- Least effective aspects:
  - o Grades for the bird house were idiotic and made no since. I know someone on the commity who got a 100 said : she worked for no more than hour : half. On the other hand my group : I spent 15+ hours on bird house and get a B. Author quizzes : exams being online was not good he would word questions wrong : would piss everyone off so he would have to change grades after they were over. On one of my exam I got an 86 and 5 days later it turned in to an 84%. On his syllabus he had quizzes posted as a certain day: the quiz would actually be a class or 2 ahead of the syllabus. I' m running out of paper, I could probably write for days on how Author is a Newb.

Techniques for Starting Large Class Discussions

Undoubtedly one of the most challenging tasks within a large class is to start a discussion. Based on recommendations found in McKeachie (200?) and Svinicki (2006) I asked 4 or 5 students, since that is about the number of areas in the auditorium, to act as 'interviewers' for the class by asking the questions that either they think other students would like to ask of if other students pass on to them questions that they would like to consider asking. The interviewers are also asked to paraphrase or summarize a question or issue from time to time as necessary to obtain clarity and a different perspective.

The first assignment is key, the typed and the background information they had to provide:
- Last name, First, Student Identification Number
- Program (ENDS, COSC, LAND, GENS, OTHER, year in the program (Fr, So, Jr, Sr)
- The minimum number of questions for chapter 1
- Any research of background information or evidence that they found interesting
- Why they chose the question, what is of interest or what peaked their curiosity on the subject?
- What would you like to be further explained about the subject?
- Did you encountered any problems with the readings, discussions or are there any unresolved problems from the previous meeting?

A short paragraph on the following
- What are your expectations for this course?
- What bugs you most about a teacher?
- What bugs you most about other students?
- What are your concerns about this course?
- What have you heard about this course?
- What grade are you willing to work for in this course?
- What would you like to know about your professor?

Observations

Although the lecture format was challenged by printing, television, teaching machines, computer and now web based on-line-learning, there appears to be a persistent need for human contact and learning that spikes curiosity, intrigue, fascination, interest, value and importance of a subject matter. The lecture/listening format emphasizes motivation and other qualitative attributes and serve as a human model of how to organize the information seeking process and models thinking strategies (see Fig. 2). The motivating aspect of my lectures, based on 30 years of experience as an architect practicing contract administration, that is where design meets construction, is to relate how and mostly why what they are learning is important, and knowing that information translates into skills that are valuable in doing things right the first time, avoiding conflict and possibly litigation. The delivery method is as important as the information and to that effect I try to make my exchanges with the students varied, full of novelty and surprising even myself in the performance. If it is interesting to me and find it enjoyable, perhaps it will transfer to the student as a subject worth of interest and enjoyment.

The readings provide a structure of an example of the data and information to be mined. As a focus of information it is a mother load, concentrated of processed and semi processed thinking patterns for the learner to practice outlining and extracting valuable insights. The ongoing discussion through WebCT/Vista/Blackboard with the class and the professor at large as well as with other selected students provides the framework for practicing thinking strategies, manipulating the evidence, applying rationality, deciphering theory and practicing scientific principles at large while learning the tools of the professional paradigm within a cultural framework.

In the proposed evaluation format there is not a class period lost to evaluations and assessment! This allow more time for class discussions, lectures and early dismissal (5 to 10 minutes) to allow brief after class student interactions. I also take considerable time 15 minutes the classes before a quiz or an exam to go over study habits, what students have reported in general that they did to improve they study and learning habits, familiarize them further with the format, and give them pointers on how to take the evaluations such as:
o   Know the material through remote and proximate preparation (see Fig. 5)
o   Go through the evaluation and answer all the question you have a reasonable degree of certainty
o   Go through the evaluation a second time and attempt those questions that you left out the first time
o   What remains are difficult questions for you, if possible for each question eliminate obvious incorrect choices and answer as many questions as possible
o   With the remainder, use your notes, books and power point slide presentation to research the most difficult questions for you
o   If running out of time, there is no penalty for incorrect answers, take what appears the most reasonable answer to you.
o   Remember that studies have shown that students usually change right to wrong answers (Mueller and Wasser (1997).

After the evaluation I also take time (15 to 20 minutes) with the entire class to keep them informed on their performance, what was the class average, how the issues of test ambiguities are handled and invite them to make an appointment to discuss in further details their study and learning habits and any assessment issue that they would like to raise.

Although not articulated by the students, I observed that in the first sessions before they learned how to access the power point presentations, which are an outline of 'what has been found important' in the chapter, the students take copious notes. Afterwards, the students stopped taking notes and just stared. For some time I thought that I had lost the students but assessments indicate that they were listening

deeply, were motivated and challenged to learn and did learned through the process. It appears that the students were thinking and elaborating knowledge by linking it with concepts, facts and principles within their own framework.

During the lectures I try to emphasize the principle at work, knowing that if grasped, the details are more easily retained. However it is the principle that if illustrated with samples and shown from different perspectives the foundation that remains after time has blown away the details into deep memory. Clarity of principles, fun in the presentation of detail is a good combination (see Fig. 8).
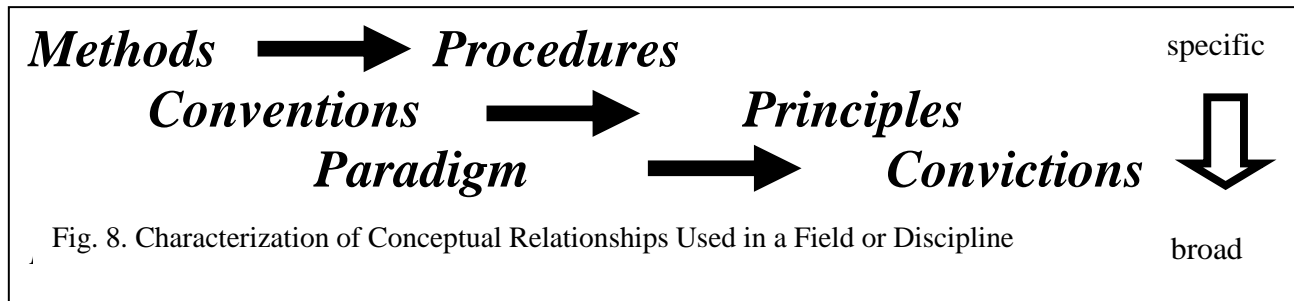

Fig. 8. Characterization of Conceptual Relationships Used in a Field or Discipline

An example of a principle: Building construction communicates graphically. I model for the student how most of what we do in design and construction is translated by visual cues such as sketches, drawings, charts, graphs etc. Students are encouraged to think visually and take notes by sketch and notations rather than sentences and words. Graphic representation increases flexibility, spontaneity and mnemonic device of association that aids information retention (Mayer 2001). By using graphic representation, students become proficient in this type of language (symbols and meanings) that the profession employs extensively. Why it that we have this intermediary form of communication? It is has to do with the fact that most human were pre-literate before the advent of the printing press. Drawings were the preferred method of communicating between the literate (royal) architect and the (mostly pre-literate) builder. Although we use words in verbal communication the preferred mode of communicating in the profession essentially remains graphical in nature.

For example, I describe a site plan in words and have the class write it out and then draw it out. We then compare notes on the final drawing that is shown on the projector. Case in point drawings are a preferred form of communication and record keeping in the built environment profession.

During the first semester, when a student came with a valid excuse for missing a quiz or an exam, all I had to do was to open up the window and the problem was solved, a practice that I have discontinued. Now, those that miss a quiz of an exam have the final comprehensive exam option to make up for one item, either a quiz or an exam. However, even though the excused student took the quiz or exam after the class, the grades were not different from his or her other grades; that is, they were in line with the individual student trend. On line testing in this fashion eliminated having to bring enough paper tests, of different versions in a crowded classroom with no empty seats to spread the students, having tests missing from the students not turning them in and the effort in passing them out, collecting the 350 tests and grading them! During the test, if it was in a classroom setting, I can envision a number of students coming to complain about ambiguous questions and wanting correction right on the spot, this potential interruption was also eliminated by on line testing.

During the first and second semester of teaching the course, only three quizzes were given and an exam covered two chapters that were covered in the previous quiz and two new chapters. The current format follows the advice of more frequent testing thus there are six quizzes and three exams. The

additional quizzes, taken individually will provide motivation at learning and mastering the material before taking an exam of a larger body of knowledge. The large database makes it likely that in the exam the students will see some of the same questions but mostly new questions that other students have experienced, thus a participatory setting for taking the exam is allowed with the hopes of generating discussion and cooperative-collaborative learning (interpreted as interdependence in working towards a common goal, Cooper et al. 2003).

Conclusions

The student evaluations of the course imply that the lack of course preparation due to the short fuse had no negative impact on the teaching or student learning. The goal of minimizing the negative and the use of instructional technologies appear to have enhanced teaching and learning. ITS was used as: a managing tool; tool for enhancing class discussions; promoting student generation of relevant and insightful questions; promoted individual, collaborative, cooperative learning ambient; and satisfied the student need for social interaction.

Where there any changes in teaching and learning practices as result of the new technology? From the teaching side, a conscious emphasis on using technology, lectures, discussions, assessments and the entire course experience as an opportunity to showcase the students how to learn a complex subject using instructional technology was a major change. From the students, according to their course evaluation and comments, it appears that there was a high level of student engagement in learning; and a high level of student interaction with the instructor and other students that was propitiated by the instructional technology.

Did the changes in teaching practice and use of technology help students achieve the course goals and learning objectives? Everyone that took the final comprehensive examination option had a remarkable increase in score from the pre-test FCE; students report that they not only learned but enjoyed the course and research indicates that learning is more permanent when it is enjoyable.

How does the technology impact teaching and learning efficiently? From an instructor point of view it allows a one source course management system that is integrated; the use of time for student interaction instead of grading and managing complaints; was able to put what was learned in practice, on the run, then the following semester investigated the principles and theory behind and evolved the course for a third presentation with better preparation and management skills.

Improvements and Further Research

Undoubtedly the student response system (also known as clicker) would be an excellent tool to have in class to improve student participation and discussion, however at the time these two courses were offered the clicker was not properly synchronized with WebCT/Vista/Blackboard/Vista 4.0 version and could not be relied upon.

There are several areas of improvement that come to mind: One is to convert the PowerPoint presentations from content outline to content questions; the other is to increase the number of case studies during the course that are specifically tailored to the course material; incorporate the minute and 'half sheet' papers; use the student response system as soon as it is compatible with Blackboard; learning to use an electronic appointment calendar and tie it in with one master calendar; using the concept of virtual office hours thus being available on line at announced times for the students; visiting and observing other successful large classes; videotaping a class and reviewing it with the Center for Teaching Excellence continue practicing pin-drop silence (pregnant pauses) to allow concepts to sink

in; continue mastering the art of creating a virtual picture of what is being said for the students to grasp; practice on the spot cadence to allow for a performance with breaks.

The findings of teaching this course two semesters needs further study and corroboration. I am planning, if given the opportunity to continue teaching the course with the syllabus and set up mentioned in this paper and add to the findings as well as learn to interpret what the students are learning with this process. I hope that in four years, when the freshmen 06 begin graduating to have the opportunity of performing an exit interview on what they learned the most in COSC 253. My hopes that it is nothing in particular, just that they learned how to learn and that it helped them throughout their university experience.

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Appendix 1

Column Statistics for: Final Grade   COSC 253 Fall 06

Count:	**324**
Average:	**83.8**
Median:	**85.8**
Maximum:	**96.6** out of 100
Minimum:	**10.3**
Standard Deviation:	**11.51**

Grade Histogram
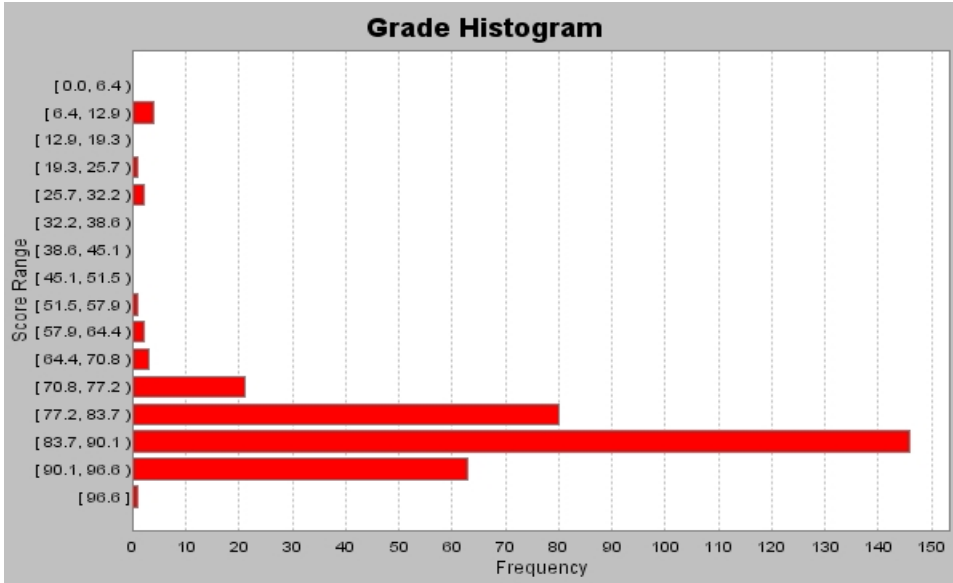
Column Statistics for: Final Grade   COSC 253 Spring 07

Count:	**251**
Average:	**78.2**
Median:	**84.6**
Maximum:	**96.4** out of 100
Minimum:	**5**
Standard Deviation:	**22.3**

Grade Histogram
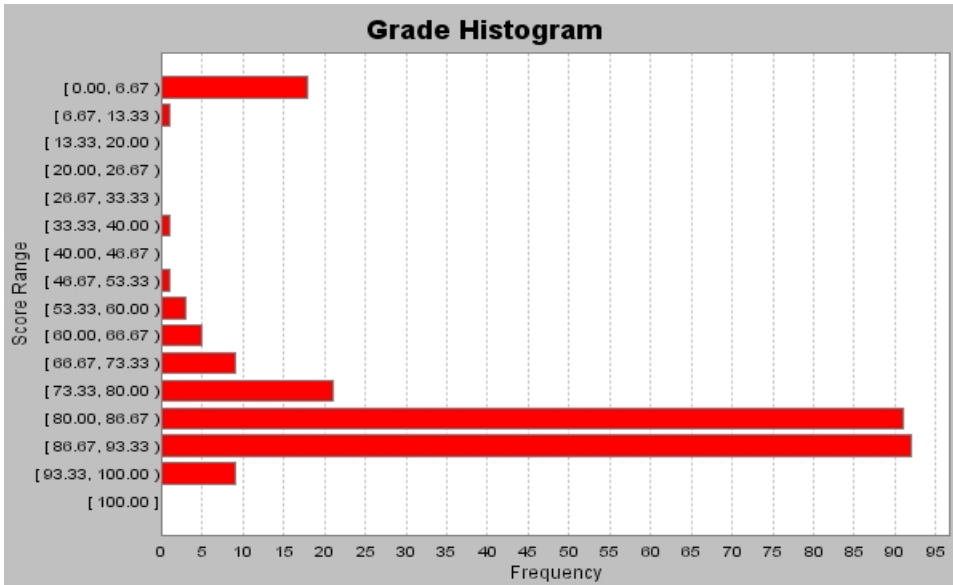
Appendix 2
EARLY FEEDBACK PROGRAM and END OF THE SEMESTER
STUDENT EVALUATION AND COMMENTS
COSC 253, SECTION 500

Course evaluations statistics for the fall, 2006 end of the semester:
Department mean = 4.255
Department median = 4.320
Std Dev = 0.427; Min = 2.82; Max = 4.92
Total course count for semester = 55

	EARLY FEEDBACK PROGRAM		**END OF THE SEMESTER**	
Overall Paticipants/Mean	**191/3.89**		**159/4.36**	

1. The instructor is well-prepared for each class.

Response	Frequency	Percent	Frequency	Percent
Strongly agree	94	49.0%	106	67.1%
Agree	88	45.8%	41	25.9%
Undecided	9	4.7%	9	5.7%
Disagree	1	0.5%	2	1.3%
Strongly disagree	0	0.0%	0	0.0%
Mean		**4.26**		**4.59**

2. The instructor appears to have a thorough knowledge of the subject.

Response	Frequency	Percent	Frequency	Percent
Strongly agree	145	75.9%	134	84.8%
Agree	46	24.1%	21	13.3%
Undecided	0	0.0%	3	1.9%
Disagree	0	0.0%	0	0.0%
Strongly disagree	0	0.0%	0	0.0%
Mean		**4.55**		**4.83**

3. The instructor sets high standards for students.

Response	Frequency	Percent	Frequency	Percent
Strongly agree	77	40.1%	84	53.8%
Agree	103	53.6%	60	38.5%
Undecided	12	6.3%	12	7.7%
Disagree	0	0.0%	0	0.0%
Strongly disagree	0	0.0%	0	0.0%
Mean		**4.17**		**4.46**

4. The instructor makes important principles and ideas clear for this subject matter.

Response	Frequency	Percent	Frequency	Percent
Strongly agree	51	27.0%	66	42.3%
Agree	81	42.9%	57	36.5%
Undecided	41	21.7%	26	16.7%
Disagree	14	7.4%	5	3.2%
Strongly disagree	2	1.1%	2	1.3%
Mean		**3.66**		**4.15**

5. The instructor keeps students informed of their progress.

Response	Frequency	Percent	Frequency	Percent
Strongly agree	44	23.2%	88	56.1%
Agree	75	39.5%	53	33.8%
Undecided	61	32.1%	12	7.6%
Disagree	9	4.7%	2	1.3%
Strongly disagree	1	0.5%	2	1.3%
Mean		**3.61**		**4.42**

6. I believe this instructor is an effective teacher.

Response	Frequency	Percent	Frequency	Percent
Strongly agree	51	26.7%	80	51.0%
Agree	87	45.5%	47	29.9%
Undecided	37	19.4%	17	10.8%
Disagree	11	5.8%	9	5.7%
Strongly disagree	5	2.6%	4	2.5%
Mean		**3.71**		**4.21**

7. I am gaining a good understanding of concepts/principles in this course.

Response	Frequency	Percent	Frequency	Percent
Strongly agree	43	22.4%	55	35.0%
Agree	81	42.2%	70	44.6%
Undecided	50	26.0%	21	13.4%
Disagree	17	8.9%	11	7.0%
Strongly disagree	1	0.5%	0	0.0%
Mean		**3.62**		**4.08**

8. Work requirements and evaluation system are clear and summarized on the course syllabus.

Response	Frequency	Percent	Frequency	Percent
Strongly agree	50	26.2%	81	51.3%
Agree	110	57.6%	54	34.2%
Undecided	20	10.5%	19	12.0%
Disagree	9	4.7%	4	2.5%
Strongly disagree	2	1.0%	0	0.0%
Mean		**3.85**		**4.34**

9. The exams/projects are evaluated fairly.

Response	Frequency	Percent	Frequency	Percent
Strongly agree	33	17.3%	77	49.0%
Agree	74	38.7%	51	32.5%
Undecided	72	37.7%	17	10.8%
Disagree	8	4.2%	4	2.5%
Strongly disagree	4	2.1%	8	5.1%
Mean		**3.49**		**4.18**

10. Help is available to students who seek it.

Response	Frequency	Percent	Frequency	Percent
Strongly agree	65	34.0%	93	58.9%
Agree	89	46.6%	46	29.1%
Undecided	37	19.4%	18	11.4%
Disagree	0	0.0%	0	0.0%
Strongly disagree	0	0.0%	1	0.6%
Mean		**3.96**		**4.46**

11. On the whole this is a worthwhile course.

Response	Frequency	Percent	Frequency	Percent
Strongly agree	61	31.8%	81	51.6%
Agree	97	50.5%	50	31.8%
Undecided	25	13.0%	18	11.5%
Disagree	7	3.6%	7	4.5%
Strongly disagree	2	1.0%	1	0.6%
Mean		**3.92**		**4.29**