Grounding the Use of Instructional Technology in Large Classes

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Out of necessity, when assigned to teach a large introductory class in Construction Science, we quickly learned the requisite instructional technology and its application. 'Learning how to learn' (Weinstein 1996) was the ultimate 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, we sought coaching from Texas A&M University's Center for Teaching Excellence (CTE). This provided an opportunity to reflect on what happened, clarify the theories, examine our teaching philosophy and further clarify the principles that informed the framework for the course. This paper reports on the result of this reflection and is based on wisdom-of-practice scholarship (Weimer, 2006); therefore, it is experience-based and subjective. This paper follows the major lines of professional teaching practice, motivation, and findings from decisions made in the process. This paper also captures the evolution of the course, and the areas indicated for further research. More importantly, it advocates a method for teaching with instructional technology (Blackboard/Vista), which needs verification by other institutions, as this becomes an area of scholarship suitable for qualitative studies, quantifiable investigations, or descriptive research.

Key Words: Learning, Philosophy, Principle, Teaching Theory, Large Classes

Background

According to McKeachie and Svinicki (2006), "teaching skillfully may be less time consuming that teaching badly." Aware that a professor's time is limited, we sought ways to maximize doing good, while minimizing doing damage. A 325 student class management system was necessary to minimize administration and maximize communications so that everyone had the latest version of the syllabus, assignments, deadlines, quizzes and exams, and handle the many challenging day to day activities--a system that could operate as "information and communications central 24/7."

This paper is based on the two types of literature found in the field of teaching by Weimer (2006): wisdom-of-practice scholarship and empirical research scholarship. Wisdom-of-practice scholarship includes personal accounts of change, recommended-practice reports, recommended-content reports and personal narratives. Empirical research scholarship on teaching includes quantitative investigations, qualitative studies and descriptive research. From the above divisions, this paper falls into the category of a recommended-practice report. This paper 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 kinds of knowing are already embedded in competent practice."

This paper purports to be more than an anecdotal success story; rather, it embraces discipline and inclusive scholarship, recognizing that "knowledge is acquired through research, synthesis, practice and teaching," paraphrasing the words of Ernie Boyer from a decade ago (Bloom et al. 1956).

General Principle

"We learn if we are extrinsically and intrinsically motivated to learn" (Hofer et al. 1998). In general, we view the classroom as an opportunity for teaching students how to eventually achieve freedom from the institutional educational system so that they may continue learning anything relevant, interesting or necessary in life. Teaching large classes requires a mindset that takes into account how students learn, and how to be efficient with administrative work and organization (see Fig. 1); along the way, students learn to take responsibility for their own

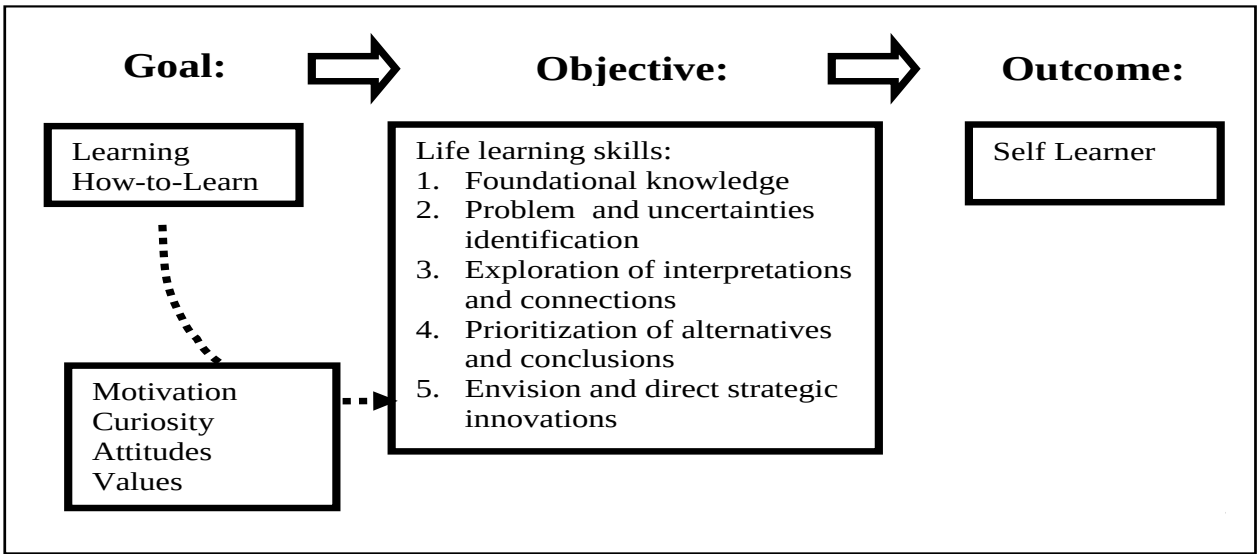

Figure 1: Operational Definitions adapted from Wolcott (2000, 2006)

learning (also referred to as self-monitoring or self-motivation).

Mindset

Entry level courses, rather than focusing on details of information transfer, should teach students how to discern what is important, as well as where to find and how to filter information; essentially, how to learn and think. This is how teachers supplant magic (Fraiberg 1996) with science. McKeachie and Svinicki (2006) succinctly describe the classroom transition in six points: (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; and (6) Reflect on what your students need to accomplish to learn how-to-learn. Presenting lectures rely on students' reading and listening,

offers passive learning (Bain 2004; Bligh 2000). Alternatively, discussions are considered the most effective way to learn **(**see Fig. 2). The ideal situation appears to be if the entire class, or sub-groups, are able to discuss a subject at their own pace. The guiding principle is that interactions that facilitate learning need not be limited to those with teachers.

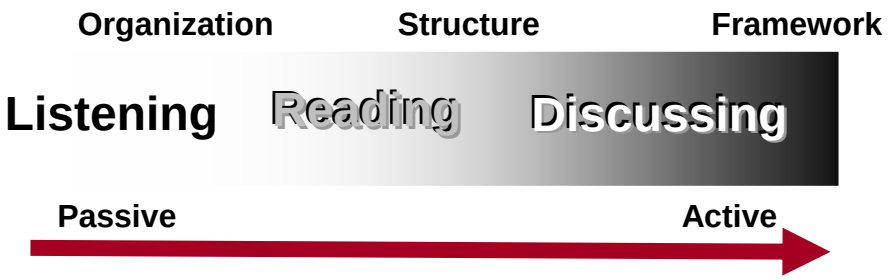

Figure 2. Gradations of Learning Modes (Adapted from McKeachie and Svinicki (2006)

Tools of the Trade

Faculty is charged with three objectives: teaching (knowledge transfer), research (grant oriented) and service (organizational preservation and improvement). Our focus on teaching has two major components: administration and teaching. Administrative tasks (preparation, assessment, evaluation, and grading) for very large classes, if approached in the same way as small classes, will consume an inordinate amount of time. Teaching tasks (individual student attention, motivation and counseling as well as lectures) for a very large class also require an inordinate amount of time (Brookfield and Preskill 1999). For the class in the present study, several tools were employed to maximize student interaction and minimize administrative time. For teaching, besides the ongoing departmental Academy, the professor enrolled in programs from the Center for Teaching Excellence (CTE), such as:

- Inquiry Based Learning Workshop
- Teaching with Blogs and Wikis
- Enhancing Critical Thinking Skills by Susan K. Wolcott
- Developing Students' Critical Thinking Skills by Susan K. Wolcott
- Course Development I: Beginning With the End in Mind
- Course Development II: Assessment and Feedback that Demonstrates Student Learning
- 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

Complementing the class management knowledge gained through workshops was the adoption of a technological tool, Blackboard/Vista, which offers numerous means to manage a large class. Of the many features for course management, the most used ones are, in alphabetical order: Announcements (pop-up when students log in); Assessments; Assignments; Calendar; Discussions; Grade Book; Mail; Resources; Roster; Syllabus; Who is on Line. These features not only aid the professor, they also enhance communication with and among students in the class.

Thoughts on Assessing Large Classes

Learning assessments and evaluations are a major component of course administration. For this course, we investigated how assessments could become more of a learning tool (Brown 1978; Brown et al. 1986). In general, assessments require reasonable effort, yet they can be quite interesting. We sought ways to assist students in achieving mastery (demonstrated by a desire to know) rather than performance (demonstrated by a desire to impress). Students interested in mastery view mistakes as opportunities, while students interested in performance view them as character flaws. These two situations represent extrinsic (external reward) and intrinsic (self reward) motivations (Walvoord and Anderson 1998).

Class set up

The class covered twelve chapters and originally we decided assessed two chapters with a quiz, and then the same two chapters plus the next two chapters with an exam. After that, we altered the system to test every two chapters with a quiz, every four chapters with an exam and the entire course with a comprehensive exam, making the process semi-cumulative. Literature recommends assessing often when using it as a tool for learning.

Although assessment forms a large part of the academic experience, learning is both an individual and a social endeavor (Pan 2001). In general, the bonds with other students and the professor form a social support system that enhances student motivation, class attendance and participation. In this class example, Blackboard/Vista allowed each student to post a picture on the class roster, thus making it easier for students and the professor to learn students' names, and form groups with others in the class (see Figure. 3).

Figure 3: Typical Roster Information in Blackboard

Mitigating Assessment Anxiety

Assessments measure how each student learns the essence, the building blocks, of the profession, materials and methods. Progress in learning is more important than grade progress, although a score indicates performance at one moment in time; as such, it carries for the student a certain level of related anxiety. Anxiety is an ongoing issue that must be treated throughout the semester--it starts with the first day and continues in every class. Sadker and Zittleman, (2004) indicate that student anxiety may be ameliorated through granting students a certain control over the assessment process.

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

One step in mitigating anxiety was to boost familiarity with course and exam material. During the second week of class, students were given a fixed bonus point on the previous semester's comprehensive final exam (CFE). For this bonus exam, we asked the students to not study, and use no books or notes--just become exposed to taking an exam with Blackboard/Vista and become exposed to the types of questions they would later encounter in an exam. This would be used later to measure students' learning, but it also aimed to lower assessment anxiety for students.

Assessment Set-up

If students take an exam within a window where they can choose the day, time and place, how does one control cheating? Cheating is a major concern for any institution that is primarily focused on testing. If assessments are viewed as a method of learning, cheating is understood from one perspective. In this course syllabus, under the honor code, it stated that quizzes were to be taken alone, but exams could be taken individually, with another or in a group. As a matter of fact, each exam asks: Are you taking this exam: alone, with another, with two others, with three others or with more than three. Exams with a group option 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.

The students answered the question about how they were taking the exam with no self-incrimination. Very interesting results came from this experiment. Students, after taking the first exam in a group, realized that they were taking the exam multiple times, and the help from other students was minimal or not reliable (some even mentioned that they would have answered a question differently but were persuaded); these students took the remaining exams alone. This left those not at the top of the class helping one another; however, when comparing the grades

students made on a quiz (alone) with those on an exam (possibly with others), there was no significant difference.

The database of questions was composed of several layers. The question set for any one chapter contained questions from previous semesters, questions that the students created and perhaps were adapted 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. Additionally, any question previously found to be ambiguous was deleted from the database. Perhaps the large database of relevant questions and the fact that the computer randomized each test question to mitigate the possibility of any group of students seeing the same test, contributed to the quiz and exam grades being similar. However, the most important concept behind this set up is that the students were motivated to read the assignments and make up questions for a database they were able to see through the Blackboard/Vista Discussion section for each chapter. This gave them insight into what other students found interesting and important, plus the professor's comments on the posted questions. This built their confidence in learning what was important to learn. The principle behind this was that "training students to generate thought-provoking questions enhances learning" Wolcott, 2000. This approach (students generating questions) goes beyond the think-pare-share.

Generally, students were encouraged to see how a question could be worded differently or information presented in a questioning form, and with practice, their questions were neither too easy, giving away the solution, nor too difficult, out of a recondite context that did not test knowledge. However, all questions required careful review by the professor, a linguistic editor, and a final review, with the overall mosaic of questions in the database chosen to see if a picture of knowledge and learning was somehow discernible. In other words, the assignment of writing a minimum of two questions per chapter, one T/F and one MC per student (a class of 200-300+ students generated a considerable number of questions) accomplished the following:

- The whole class became a discussion group, as well as established possible sub-groups for study
- Discussion and thinking about how an item of learning could be posed as a question with the goal of getting it included in the database (student advantage)
- Discussion about how a question could be altered and how it could re-appear as a higher-level question (this required that students think about the material mostly through discussions, Whilite 1983), per the following examples of questions that have been elevated in critical thinking (Prus and Johnson 1994; McKenna and Bull 2006):
  - (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) Examine the validity of an argument and determine which is the weakest link.
  - (TF) Compare one theory with another
  - (TF) The following are important <u>dimensions</u> (points, criteria, characteristics, attributes) in a comparison
  - (TF) Evaluate, compare or judge the relative values of a _____ in an argument.

The objectives were:

1. Present the students with 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 plenty of examples of how to become self-learners by using bricks and mortar, nails and other common materials and processes as tools.
3. Model why it is important that they become self learners through lessons learned, case studies and the rationale (deeper thinking) behind common occurrences and processes.
4. Showcase how to evaluate the evidence behind a product or a manufacturing process, mostly using a historical perspective. In other words, demonstrate how to search for and analyze the rationale underlying what is done 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 the possible solutions?
    d. Evaluate these possible solutions against the criteria of the characteristics of an acceptable solution

The class then became one big study group, with sub-groups discussing the class material, in a total learning program (see Figure 4).

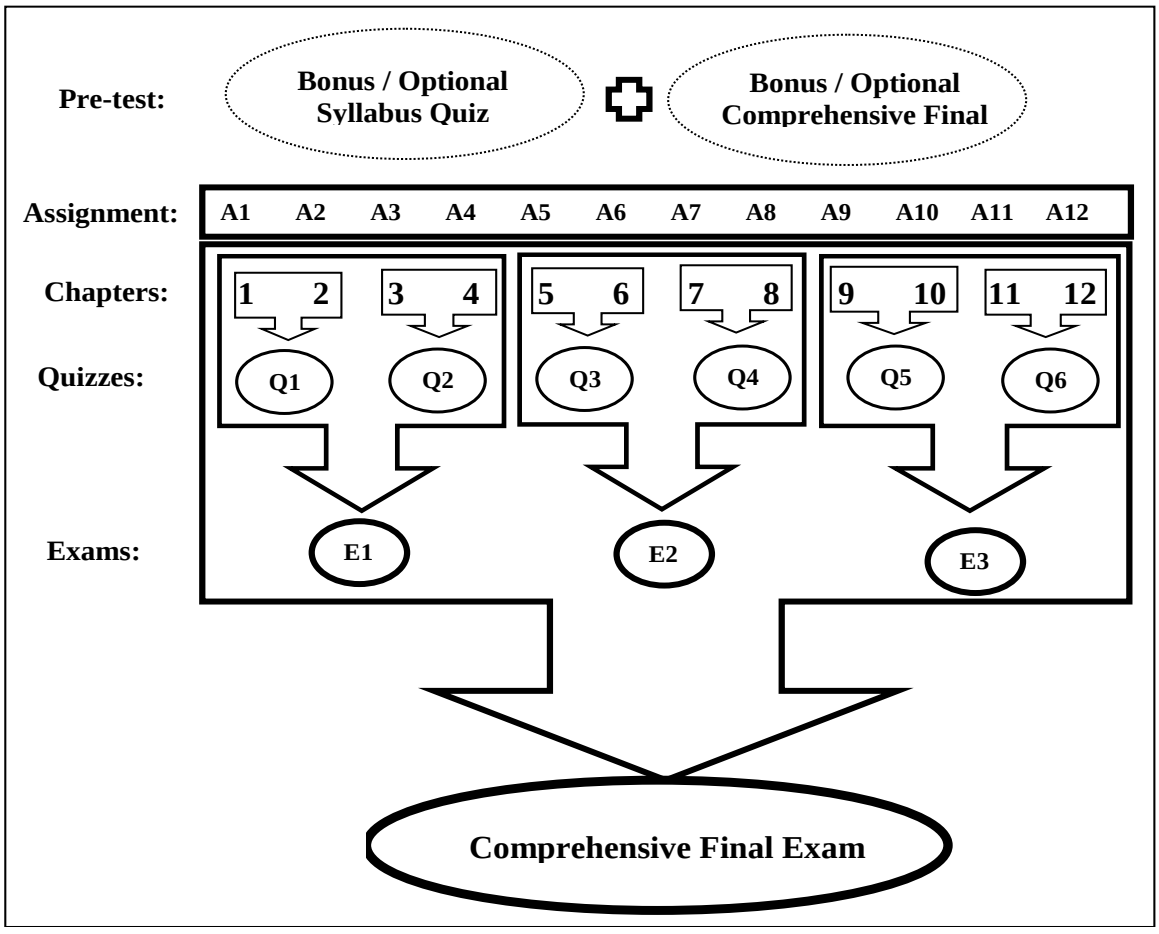

Figure 4: Total Learning Program

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%

The comprehensive final exam at the end of the semester was an optional exam that students could take in a group or individually, open book and notes, with an ample window and sufficient time to finish. This took away the pressure for the students, especially if they scored higher than on a previous exam. For those that missed a quiz or an exam, even though there was an ample time window and they could have logged in and taken the exam from any computer in the world, the final exam option was their only make up opportunity.

Notice the standard deviation among quizzes (see Table 2) and among exams: they are precisely at acceptable values. The difference between the standard deviation for quizzes and that for exams is also within acceptable tolerances. The final grade has an even lower standard deviation. In the end, what students remember a week or a year after the course is more appropriately gauged by the pre-test comprehensive final exam compared to the Optional Comprehensive Final Exam, which supposedly was completed under minimal performance pressure, except for those that had missed a quiz or an exam.

Evaluations – Optional Final Comprehensive Exams

A final comprehensive exam typically brings an inordinate degree of anxiety to students, which may dissipate when it is made optional, as was the case for this class. Approximately 21% took the Optional Final Comprehensive Exam: 52% of those improved their grades, 10% already had an A and 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 improve their grades (see Table 1).

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 reflected what student will remember in a week, a month, a year, was 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 exams were crafted with the primary intent of being tools for learning, and secondarily, for assessment, it can be inferred that the final grade was first a representation of learning and secondarily a comparison of each student with self and with the class. 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 which questions were ambiguous. The opportunity to take the exams as a group could also be construed as a benchmark of the class or sub group to which a student contributes, and against which they are compared (see Table 2). The average score and the standard deviations are within academic acceptable levels.

Table 2. COSC 253 Spring 2007 (Sample) Pre-test

Final Grade	Quiz #1	Quiz #2	Quiz #3	Exam #1	Exam #2	Exam #3	Syllabus Quiz	Optional Comp. Final Exam	Optional Comp. Final Exam	Evaluation
100	100	100	100	200	200	200	10	120	120	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	Std Dev.
	24/16	20/20	20/20	20/20	20/20	20/20	5/5	60/60	60/60	T/ F or MC

The professor's questions based on class presentations that augmented the course content appeared to be the principal differentiator when reviewing with students the questions that they missed. If someone in the group was not present in class to capture what was discussed, there was a gap in the knowledge that the group or individual could not surmount.

Course Evaluation and Feedback

Table 3 is a comparison of the final course evaluations filed with the department. The course was also observed by the CTE and a critique made. The majority of students scoring the highest grades took the course exams individually. However, the ones that formed a group through discussion, and then interfaced with each other, learned how to learn, as well. Most failing grades came from students that dropped out of the course for various reasons, but the system carried their presence until the end and they had to be accounted for with a grade.

Both courses were evaluated at the end of the semester. However since this course was taught during the fall, only one score applies as noted.

Table 3. Student Evaluations: COSC Dept. average and Dr. Solis average

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

Conclusions

According to the student evaluations of the course, we can infer that lack of time for course preparation had no negative impact on either teaching or student learning. Minimizing the negative through the use of instructional technologies appears to have enhanced teaching and learning. The course management tool, Blackboard/Vista, along with enhanced class discussions, and student generation of relevant and insightful questions, promoted individual, collaborative, and cooperative learning. It also promoted an atmosphere that satisfied the students' needs for social interaction.

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 reported that they not only learned but enjoyed the course and research indicates that learning is more permanent when it is enjoyable.

How did the technology impact teaching and learning efficiently? From an instructor's point of view, the integrated course management system enhanced the use of time for student interaction instead of grading and managing complaints. The instructor then put what was learned into practice, during the semester, then later more fully investigated the principles and theory behind the class's management, and evolved the course for a third presentation with better preparation and management skills.

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