

## **TIME AND TIME AGAIN --A Comparison of Faculty Time on Tasks for a Lecture Class and a CDROM Based, Self Paced Class**

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Detailed logs were maintained for faculty time on various tasks for teaching a fundamentals engineering class. A comparison is made between time given for tasks in teaching in a traditional lecture format versus that for teaching the same class in a new format using a CDROM, self-pace method. We call this a distributed method. The learning by both methods resulted in the same results on the comprehensive final examination. There is, however, a significant difference in how the professor used his time. Total hours given to the class may be lower for the CDROM class and teacher time shifted from lecture preparation and presentation to helping students by formal group tutoring and individual sessions. Results from teaching one lecture class of 47 students and three classes of CDROM sections of 27, 75 and 85 students are presented. Details about time distribution among various tasks are given.

### The Purpose

Our purpose in this on going project has been to find a learning method that blends some of the best attributes of the time tested lecture class and those of the newer technologies. We are seeking statistical data that might show any advantages over the learning and teaching that results from using only the lecture method. Over the past three years of this study we have also gathered detailed data about how a teacher spends time in delivering our fundamentals in chemical engineering class. Much of the other results about learning success, student motivations and their attributes and learning styles for this study have already been presented<sup>1, 2, 3, 4, 5, 6</sup>. Here we show how time on tasks was different for the professor in delivering this new method, called distributive method, compared to the traditional lecture format.

### The Method

In fall 1999 two sections of our fundamentals of chemical engineering course were taught, one using the full lecture format and the other using our experimental approach. Then in the fall of 2000 and 2001, one section only was taught using the distributive method. This makes a total of four sections during which full logs were taken on teacher time spent on various instructional tasks. One section of 47 students was taught (Fall 99) using the traditional three lectures a week, 50 minutes each; three examinations and a comprehensive final. Also, homework was given and an occasional pop quiz presented. This section was organized to be as traditional as possible, including a required standard textbook. No CDROM nor any form of technology was used.

The other three sections were taught using the distributive approach and had 27, 85 and 99 students each at the start of the semester. The 27-student section was taught the same semester, 1999, as the lecture section, only two hours later in the afternoon.

The format for our distributive method was as follows:

- all course content was provided on a CDROM specially developed for the course, text was optional but recommended,
- class met **only** every Wednesday, required, but Monday and Friday class periods were used for tutoring those who requested it or for mastery testing of the modules,
- students were free to progress through the 12 modules at their own pace but no slower than the published minimum rate,
- students were free to try each module mastery test more than once but a small penalty was assessed for multiple testing only during the Fall 01 semester,
- weekly homework assignments were given and often a 10 point, announced quiz was given during the required Wednesday meeting,
- a comprehensive final examination was given at the end of the semester,
- students who finished the modules early (one did so a full month early) still had to attend the Wednesday classes and take the semester end final,
- the course grade was determined by weighting students' performance on the mastery tests, the final, quiz and home work grades; with emphasis on the first two items.

This format was developed to free students who do not need the three times a week lecture and who wish to proceed through the course at a faster pace. Further, it was designed to free faculty time to help those students who need and want more help and attention (this on Mondays and Fridays as well as usual office hours). The CDROM was developed by us to contain all course content, to accommodate multiple learning styles, to be highly examples and illustrations based and with a lively, interesting format to encourage its use<sup>7,8</sup>. The CDROM was never designed to replace a text. By setting a minimum progression rate through the modules mastery tests, no student would fall behind and all would be ready to take the semester end, comprehensive examination. Of course, students must have sufficient discipline and knowledge of their deficiencies to know when to come for tutoring on Mondays or Fridays or to office hours for help. I was always available for tutoring on Mondays and Fridays even if only a single student asked for it. A proctor would give the mastery tests unless I was not required for tutoring.

During the day throughout the entire semester, whenever an effort was given to the course, the time on task was recorded. This included efforts under the following categories:

- class preparation
- test preparation
- grading
- tutoring (Monday and Friday)
- class meeting
- students meetings, office hours and drop ins

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- teaching assistants meetings
- e-mail and Blackboard course management
- homework preparation
- other, a catch all for everything else.

Two teaching assistants were used to grade only the homework. I graded all quizzes, modules mastery tests and the final examination. Because we were in a developmental phase for this delivery method, I felt it was necessary for me to closely track each student's performance. Besides, we were taking many other forms of statistical data that required me to follow my students' performance in detail. Of course, this will result in a larger percent of my time being given to the "grading" category above. More will be mentioned about this later.

### Where The Time Goes

Table 1 shows the enrollment at the semester start and the average we used to normalize the class section enrollments to a common size for comparisons. In any class there are drops during the first few weeks, the final enrollments shown in Table 1 represent the class size over most of the instructional period. The data presented in the other tables have been normalized to the lecture section size of 47 students. By normalizing we mean simply adjusting the hours actually given on some tasks by the ratio of class sizes. For instance, tutoring, student advising, grading, e-mail all are class size sensitive, but items like class preparation and presentation are not. The classes had to be prepared and presented whether 27 or 99 students were enrolled.

Actually, the format of the three distributed sections change somewhat from the Fall 99 to the Fall 01 classes. The modifications were made as we evaluated our data after each semester's end. The changes that we made are as follows:

- Fall 99 section permitted repeated modules mastery testing without limit and without penalty, most tried each only two or three times,
- Fall 99 section used Mondays and Fridays almost entirely for testing with little tutoring on these days,
- Fall 00 section again permitted the same unlimited testing without penalty but the Mondays and Fridays meetings were used mostly for tutoring,
- Fall 01 section was permitted to take each module test only twice and the two scores were weighted 30:70, lowest: highest.

These changes were made because we found no advantage in student learning in making multiple testing available, and because too much time was consumed in test preparation and grading. A stronger emphasis was made to get students to take advantage of the Monday and Friday tutoring periods.

Table 2 shows the hours on various teaching tasks with each section normalized to the lecture class size of 47 students. Note that the total hours given to the sections over the entire semesters( last column) vary only slightly from 146 to 173 hours. In these tables, "Tutoring" refers to time taken on the scheduled Mondays and Fridays set aside for tutoring or testing. Other forms of

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student help, as mentioned, were provided during office hours and during drop-ins. Another observation is that the lecture class was taught by a professor who had taught this class many times in the past but this was the first time to teach it in 15 years and all notes, problems, tests and homework were prepared new. The text was a new one also. This means the time taken for class preparation will be somewhat higher than expected for a professor who has taught the class recently and was familiar with the text and could “recycle” some problems and other material.

Table 3 is the best perspective to see the time use on a comparison basis. The greatest differences between the lecture format and the distributed format is seen to be in the following areas:

- |                                       |      |             |           |                 |
|---------------------------------------|------|-------------|-----------|-----------------|
| • class preparation and presentation, | 57%  | for lecture | 14 to 23% | distributed     |
| • tutoring and helping students,      | 7%   | “           | 16 to 20  | (excludes F 99) |
| • testing, preparation, grading       | 24%  | “           | 40 to 50% |                 |
| • e-mail and electronic management    | 0.3% | “           | 3 to 4%   |                 |

This shows one-third to one-half reduction in time needed for class duties in the distributed format compared to the lecture method. More importantly, from twice to three times the amount of time was given to student helping, the distributed over the lecture. The electronic traffic increases in the distributed method because this soon becomes the best way to contact the entire class with only one required meeting a week and because there is a minimum modules mastery test schedule to track. Total test related duties are almost double in the distributed classes over the lecture class. This is discussed further in the following section.

### Observations and Recommendations

We have migrated from the belief that learning would be enhanced by encouraging students to try the mastery tests as often as they liked, and without penalty, to our present position that students will have but one try on each mastery test. What ever they make, that’s their recorded score. We soon found that contrary to the spirit of our mission, many students simply took the tests several times to “fish” for details on what to expect without any regard to understanding the concepts. And, why not, there was no penalty except use of their time. Even with a twice testing option and a small penalty, many felt it worth their time and penalty to “explore” what the teacher wanted. Further more, the burden on the teacher to prepare and grade multiple but hopefully similar tests, was too great. We believe the same, possibly more, learning will result if the students know they must come prepared with a grounded understanding of the concepts at test time.

Our distributed format offers great temptation to the less organized and undisciplined students. It is a chance to “blow off” some Mondays and Fridays. It can also be a trap to the poor learner -- the surface learners -- because these students will often not know enough to realize they need tutoring or help.

An overwhelming number of students appreciate the opportunity to move ahead and complete the class early, or at least redirect, their time to other classes. We all know that too often a great number of our students just do not need to sit through three lectures a week from a professor who

itches the material to the lower half of the class. It is this part of the class the teacher needs to spend more time with in tutoring and special help.

So what would the time on task distribution look like with this modification to only one test? Look at Table 4, which shows a modification of Fall 01 semester hours on tasks. About half the class took the tests twice; hence, I've reduced the test preparation and grading times by a fourth those listed in Table 2. Nothing else was modified. The total time on tasks reduced from 162 to 147 hours and, of course, this drop comes from the test preparation and grading efforts.

As mentioned previously the professor graded all quizzes, tests and the final as necessary to better understand the experiment, student learning attributes and their progress. Table 5 shows another modified Fall 01 task listing with the teaching assistants grading every thing except the final examinations. There is a reduction in grading, but not zero because the final was graded, and a slight increase in time to instruct the teaching assistants was added. The total time given to the semester tasks falls from 147 to 124 hours. Thus, relative to the distributed method, the lecture method could take about 19% more faculty time. This time savings could be redirected to more student help, other classes, and other duties or volunteering for committee work, if you are not yet tenured.

## Conclusions

Our distributed method of teaching offers a way to significantly free both student and faculty time for better uses. Students may progress through the class much faster than dictated by the three semester a week lecture schedule. More faculty time can be directed toward helping students who need it. Care must be taken that students do not become entrapped by the temptations of not coming to the optional tutoring days or that they fail to recognize they need the extra help. We estimate from 15 to 20 % less faculty time is needed in our distributed format, depending upon the teacher's style.

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#### Biography

Billy L. Crynes served as Dean, College of Engineering for 11 years and is currently Professor, School of Chemical Engineering and Materials Science, at the University of Oklahoma. His areas of technical expertise include kinetics, catalysis, and reaction engineering. In the last five years he has emphasized computer and other forms of information technology applied to engineering education.

TABLE 1 CLASS SIZES AT START AND SEMESTER AVERAGE USED IN STUDY		
	START	USED IN STUDY
Fall 99 Lecture	52	47
Fall 99 Distributed	27	27
Fall 00 Distributed	85	75
Fall 01 Distributed	99	85

TABLE 2 HOURS ON TASKS NORMALIZED TO A CLASS OF 47 STUDENTS													
	Class Prep	Class Present	Tutoring	Student Help	Grading	Test Prep	Testing	TA Meeting	Homework Prep	E- mail	Message Posting	Other	Total Hours
Fall 99 Lecture	44	42	0	10	23	9	5	1	2.3	0.5	0	15	152
Fall 99 Distributed	8	13	0	9	42	15	28	9	2.3	2	3	15	146
Fall 00 Distributed	14	14	8	20	55	30	11	2	2.7	1.9	3.6	11	174
Fall 01 Distributed	23	14	9	23	38	17	9	2	2	2	2.4	20	161

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TABLE 3  
PERCENT TIME ON TASKS NORMALIZED FOR CLASS OF 47

	Class Prep	Class Present	Tutoring	Student Help	Grading	Test Prep	Testing	TA Meeting	Homework Prep	E- Mail	Message Posting	Other	Total Hours
Fall 99 Lecture	29	27.7	0	6.6	15.1	5.9	3.3	0.7	1.5	0.3	0	9.9	100
Fall 99 Distributed	5.5	8.9	0	6	28.8	10.3	19.2	6.2	1.6	1.4	2.1	10.3	100.3
Fall 00 Distributed	8.3	8.2	4.4	11.5	31.6	17.1	6.6	1.4	1.5	1.1	2.1	6.2	100
Fall 01 Distributed	14.4	8.4	5.8	14.4	23.3	10.8	5.6	1.2	1.2	1.2	1.5	12.3	100.1

TABLE 4  
FALL 01 TIMES AND PERCENTS MODIFIED FOR REDUCED TESTING

	Class Prep	Class Present	Tutoring	Student Help	Grading	Test Prep	Testing	TA Meeting	Homework Prep	E-Mail	Message Posting	Other	Total Hours
Hours	23	13	9	23	29	13	9	2	2	2	2	20	147
Percents	15.6	8.8	6.1	15.6	19.7	8.8	6.1	1.4	1.4	1.4	1.4	1.4	100

TABLE 5  
FALL 01 TIMES AND PERCENTS MODIFIED FOR REDUCED TESTING AND TA GRADING TESTS

	Class Prep	Class Present	Tutoring	Student Help	Grading	Test Prep	Testing	TA Meeting	Homework Prep	E-Mail	Message Posting	Other	Total Hours
Hours	23	13	9	23	5	13	9	3	2	2	2	20	124
Percents	18.5	10.5	7.3	18.5	4.0	10.5	7.3	2.4	1.6	1.6	1.6	1.6	100