

A View on Instruction: The Economics of it All

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Abstract

In the industrial engineering undergraduate curriculum, one course has followed a very traditional educational format both from the instruction and the learning point of view. The course is engineering economics. This course is a fundamental course for industrial engineers as well as for other engineering disciplines (mechanical, electrical, civil, etc.). Although there have been several initiatives to rethink this course, by and large there has been little change in the pedagogical delivery of the course material for the last number of years. This paper investigates the current (prevalent) teaching approaches to this course. An informal survey was conducted with students at two institutions to obtain the customer's prospective with respect to the use of weekly quizzes to improve student's knowledge retention. The results of the survey are analyzed and discussed in the context of traditional (receptive accrual) and non-traditional (cognitive mediational) approaches. Also discussed are the realities of the instructor's work demands, work loads, and job priorities. Suggestions are provided to practitioners and researchers on the potential instructional technique.

Introduction

The academic community has a long standing and frequently visited topic: that of how best to instruct pupils. The engineering education community is not immune to this debate (see [7], [11], and [18] to mention a few). **Specifically** in engineering, many changes are affecting the future of pedagogy as we know it. Such topics as distance learning, exporting **engineering** education [12], and softening enrollments [14] have made for a very uncertain and fluid environment for engineering educators.

Notwithstanding all these changes in technology, **environment**, and demographics, one point still holds true: there are students and there are **teachers**.¹ Thus, the transmission, acquisition, and practice of advance knowledge is a human factor **problem**.² An understanding of both, the human ability for learning and the subsequent human factor design of the instruction is crucial. This paper looks at one specific aspect of instruction and **learning** (the chunking of information) to improve the problems with short term vs. long term memory. A specific pedagogical format (weekly quizzes) was applied to a group of engineering economic students at one university. A second group of students at a second university were used as the control group. Both set of students were surveyed to determine their perceptions on the instructional technique. The results of the survey and a discussion of the implications of those studies are provided.

¹ Some believe that in the future our **children** will be taught by computers. We disagree. Just by the simple realization of the changing nature of technology, the need for instructors will in fact increase not **decrease**. Secondly, those who view the future of instruction as "computer driven," fail to see a profession as a practice which has a complex socio-technical component.

² Few, in engineering education, have approached instruction and learning **from** a human factor perspective. This is especially sad for industrial engineers who are the **guardians** of this discipline.



The Chunking of Information

Learning and instruction has been **classified** into two distinct **formats**: the receptive-accrual approach and the **cognitive-mediational** approach (see [1] and [2]). The receptive-accrual approach is what we know as traditional learning and instruction where the teacher is the provider of information, tasks, and incentives to perform. The learner's ability to learn is a function of the ability to receive information, the intelligence level, and effort of the **student**.³

The cognitive **mediational** view of learning and instruction perceives the teacher as influencing students' cognitive processes based on intrinsic (not extrinsic, as in the traditional methodology) motivation. The learner is viewed as an active, constructive, problem **solver**.⁴ In the education literature much work has been done on building students **socio-environmental** experiences to activate the learners schemata, metacognition, and knowledge strategy development. Emphasizing such things as progressive differentiation, integrative reconciliation, and the chunking of information as well as other techniques, have been proposed (see [3], [4], [5], [6], [8], [9], [10], [15], [16], [17], and [18] for further information).

This study placed an emphasis on the chunking of information. In engineering economics, as well as most engineering courses no matter the discipline, it is a standard practice to have students do homework that is graded. From an instruction point of view, this is a good practice since the learner puts into practice the techniques of the subject matter and the information processed is chunked into small bits of information which we know from an educational stand point is beneficial. The problem is that many students either don't do the homework if the assignment is not graded or end up copying. All engineering economic professors know there exists a file cabinet hidden somewhere on campus with every single homework problem solution as well as all previous tests and quizzes ever given in that institution.

Another approach to this chunking of information is to assign homework but not collect the homework and instead give a small weekly 10-15 minute quiz on the material. The opposition to such a technique usually lies in that a) professors see it as extra work and b) students will oppose this continual evaluation. **First**, the argument of excessive work has little basis because grading homework problems is far more work than a few quiz problems. The second point is debatable. Thus, we attempted to test this point with a group of students to see if the students who have weekly quizzes would perceive the valence of the chunking of information in this format to their **edification** in the subject matter.

Methodology

Engineering economics students in two universities (Texas Tech and Virginia Tech) were surveyed on effectiveness of weekly quizzes. The Texas Tech group comprised 84 students in two separate sections (with two **different** instructors). The students were given a total of 10 weekly quizzes through out the semester. The Virginia Tech group (the control group) was comprised of 415 students in two separate sections with two instructors. These students were not quizzed on a weekly basis. The students (both universities) were dispersed between all the major engineering disciplines. The questionnaire given to them is provided in Table 1. Note, question numbers 8 and 9 were different for Virginia Tech students than the ones on Table 1. Their questions read as follows: 8. I believe small 10 minute weekly quizzes administered at the end of each week would help me in understanding this course work? and 9. Having weekly quizzes (thus a variety of graded assignments) along with the regular test would help my average grade in this course?

Our general hypothesis in this study was that we would not see any difference in the distribution of answers between the two universities in questions 1 through 7 which pertain to general information about the course. With respect to questions 8 and 9 we believe that the Texas Tech group would perceive the benefit of the weekly quizzes (information **chunking**) and that the control group (Virginia Tech students) would perceive the

³This is by far the **pre-eminent** view of instruction and learning in engineering higher education.

⁴Note, **all** education may in fact use and need to use a combination of both instructional techniques [7].



quizzes either negatively or indifferently. Questions 10 through 12 were additional questions added to provide us with valuable information about the course, but not necessarily important to the study presented here.

Table 1. List of Questions in Survey

1. The workload for this course <u>was</u>	Not enough 1	Barely Enough 2	Just Right 3	A Bit Too Much 4	Way Too Much 5
2. The tests were fair in their coverage of the material covered?	Strongly Disagree 1	Disagree 2	No Opinion 3	Agree 4	Strongly Agree 5
3. The grading system for this course was fair?	Strongly Disagree 1	Disagree 2	No Opinion 3	Agree 4	Strongly Agree 5
4. The grading of the individual assignments and/or tests was fair?	Strongly Disagree 1	Disagree 2	No Opinion 3	Agree 4	Strongly Agree 5
5. An individual term paper would better this course?	Strongly Disagree 1	Disagree 2	No Opinion 3	Agree 4	Strongly Agree 5
6. A team projector case study would better this course?	Strongly Disagree 1	Disagree 2	No Opinion 3	Agree 4	Strongly Agree 5
7. I would like to see more outside lectures (people from industry) involved in this course.	Strongly Disagree 1	Disagree 2	No Opinion 3	Agree 4	Strongly Agree 5
8. The weekly quizzes aided your understanding of the course material?	Strongly Disagree 1	Disagree 2	No Opinion 3	Agree 4	Strongly Agree 5
9. The weekly quizzes helped your overall grade?	Strongly Disagree 1	Disagree 2	No Opinion 3	Agree 4	Strongly Agree 5
10. List the major strengths of this course:					
11. List the major weaknesses of this course:					
12. What recommendations would you make in order to improve this course?					

Results

The results to questions 1 through 7 are provided in Table 2. The results to questions 8 and 9 are provided in Table 3 and Figures 1 and 2. The results show, in a non-statistical way, that the general hypothesis we presented is possibly true. From Figures 1 and 2 we can discern that the Texas Tech group heavily rated the quizzes as aiding their understanding of the course material and helping their overall grade. The Virginia Tech group showed no trend (indifference) to the quizzes with respect to knowledge acquisition (Figure 1), but some trend is visible, although not as prominent as the Texas Tech group, with respect to a link between the weekly quizzes and the possible improvement of course grades (Figure 2). Note, this paper presents only preliminary results of our study. The data will be analyzed statistically as well as with respect to the expected grade of each student to see what in-depth information can be obtained from our survey.



Table 2. Survey Results for Questions 1 through 7.

		not enough	barely enough	just right	a bit too much	way too much
Raw Data	Texas Tech	4	2	72	3	
	Virginia Tech	4	3	291	99	15
% of Total	Texas Tech	4.94%	2.47%	88.89%	3.70%	0.00%
	Virginia Tech	0.97%	0.73%	70.63%	24.03%	3.64%

2. The tests were fair in their coverage of the material covered?

		strongly disagree	disagree	no opinion	agree	strongly agree
Raw Data	Texas Tech	3	10	7	52	10
	Virginia Tech	3	11	28	315	54
% of Total	Texas Tech	3.66%	12.20%	8.54%	63.41%	12.20%
	Virginia Tech	0.73%	2.68%	6.81%	76.64%	13.14%

3. The grading system for this course was fair?

		strongly disagree	disagree	no opinion	agree	strongly agree
Raw Data	Texas Tech	1	5	8	48	20
	Virginia Tech	3	15	34	303	59
% of Total	Texas Tech	1.22%	6.10%	9.76%	58.54%	24.39%
	Virginia Tech	0.72%	3.62%	8.21%	73.19%	14.25%

4. The grading of the individual assignments and/or tests was fair?

		strongly disagree	disagree	no opinion	agree	strongly agree
Raw Data	Texas Tech	2	6	7	50	17
	Virginia Tech	5	56	37	274	43
% of Total	Texas Tech	2.44%	7.32%	8.54%	60.98%	20.73%
	Virginia Tech	1.20%	13.49%	8.92%	66.02%	10.36%

5. An individual term paper would better this course?

		strongly disagree	disagree	no opinion	agree	strongly agree
Raw Data	Texas Tech	40	25	9	2	6
	Virginia Tech	190	161	38	12	10
% of Total	Texas Tech	48.78%	30.49%	10.98%	2.44%	7.32%
	Virginia Tech	46.23%	39.17%	9.25%	2.92%	2.43%

6. A team projector case study would better this course?

		strongly disagree	disagree	no opinion	agree	strongly agree
Raw Data	Texas Tech	17	24	23	12	5
	Virginia Tech	84	128	80	102	12
% of Total	Texas Tech	20.99%	29.63%	28.40%	14.81%	6.17%
	Virginia Tech	20.69%	31.53%	19.70%	25.12%	2.96%

7. I would like to see more outside lectures (people from industry) involved in this course.

		strongly disagree	disagree	no opinion	agree	strongly agree
Raw Data	Texas Tech	5	12	26	34	7
	Virginia Tech	19	63	110	165	51
% of Total	Texas Tech	5.95%	14.29%	30.95%	40.48%	8.33%
	Virginia Tech	4.66%	15.44%	26.96%	40.44%	12.50%



Table 3. Survey Results for Questions 8 and 9.

Virginia Tech

8. I believe small 10 minute weekly quizzes administered at the end of each week would belt) me in understanding this course work?

	strongly disagree	disagree	no opinion	agree	strongly agree
Raw Data	33	128	71	148	22
% of Total	8.21%	31.84%	17.66%	36.82%	5.47%

9. Having weekly quizzes (thus a variety of graded assignments) along with the regular test would help my average grade in this course?

	strongly disagree	disagree	no opinion	agree	strongly agree
Raw Data	27	99	88	170	28
% of Total	6.55%	24.03%	21.36%	41.26%	6.80%

Texas Tech

8. The weekly quizzes aided your understanding of the course material?

	strongly disagree	disagree	no opinion	agree	strongly agree
Raw Data			7	47	28
% of Total	0.00%	0.00%	8.54%	57.32%	34.15%

9. The weekly quizzes helped your overall grade?

	strongly disagree	disagree	no opinion	agree	strongly agree
Raw Data	3	9	10	37	22
% of Total	3.70%	11.11%	12.35%	45.68%	27.16%

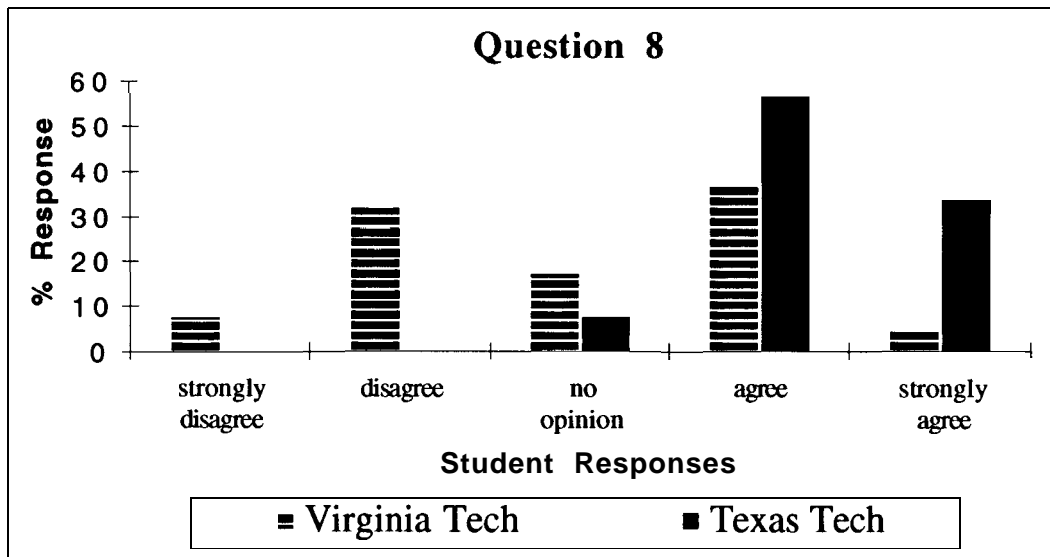


Figure 1. Question #8 Results.

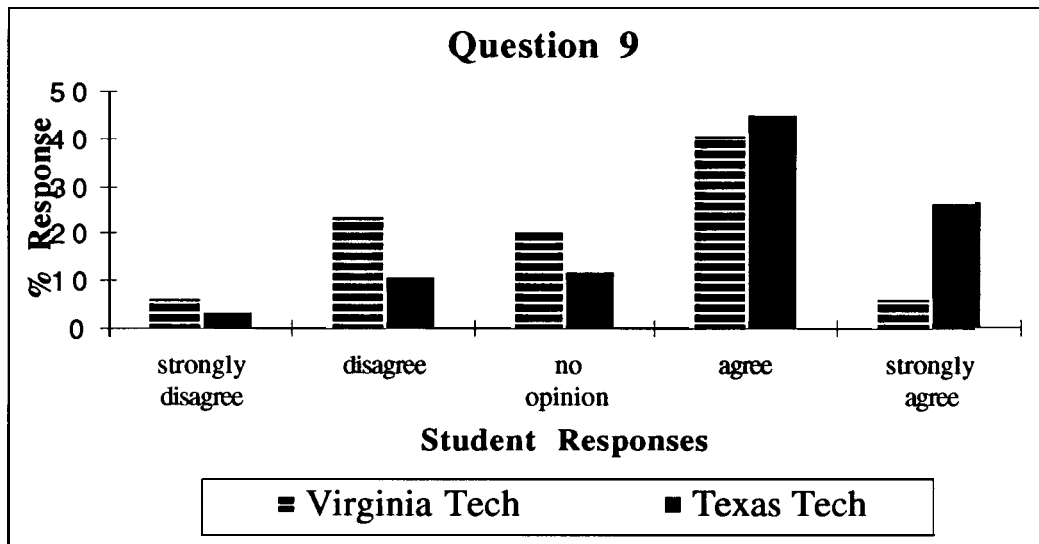


Figure 2. Question #9 Results.

Conclusion

The results obtained are both commonsensical as well as insightful. It is expected that students who are not taking the quizzes would in fact not fully comprehend the value of such a technique. It is possible even to expect these same students to oppose such structure because it entails more efforts of their part. But it is an insight that may not be expected by many engineering educators, that students do in fact see the valence of such an effort on their learning. Due to the preliminary nature of the results presented here, not many conclusions can be drawn at this time. But what is crucial is that the debate and research on this area of instruction and learning is further addressed. The use of weekly quizzes we believe increases students knowledge of the subject matter, valence of the instructional technique, as well as decrease the instructor's work load by eliminating the grading of homework.

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