Perils of Teaching Too Well: How In-Class Experience Might Motivate Students Outside of the Classroom

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ABSTRACT

Collegiate engineering students are under great pressures in the pursuit of high marks. The availability of time as a resource is one of these pressures. Many things in the students’ lives compete for that time. Class attendance is time formally set aside for students to dedicate themselves to learning the material of a particular course. The potential exists for students to rely too heavily on in-class instruction, especially if students perceive that they have a high level of understanding of the course material simply from being attentive to the instructor in class. Ideally, even if students did benefit from quality instruction and left class with a feeling of comfort regarding their understanding of what was just learned, they would still dedicate their own time to furthering that understanding, but realities of time demands must detract from this ideal. This research project explores this concept. In what way does a student’s comfort level with material presented in class affect the amount of time they dedicate to self-study? And in turn, does this have a direct impact on student performance? If a college student’s most significant learning is gained in self-study, then these are important questions. Through the collection of daily student surveys, we attempt to correlate student perceptions of comfort with time spent out-of-class. This research may give insight to best practices for motivating students. It is possible that by covering too much course material, instructors could expect too little of their students, and in-turn, provide little motivation for the student develop strong learning skills. We are intrigued by the possibility that college is not for everyone,1 but if the admissions office is functioning accurately, then there is a possibility that our courses are not designed to employ the talents of the students enrolled in them.
INTRODUCTION

It has been suggested that the most critical time spent in the pursuit of education by college level students in engineering is that time spent outside of the classroom.\textsuperscript{2} The students involved in this study attend an institution that places great demand on their time. At the United States Military Academy (USMA), students must divide their time between academic pursuits, military requirements, and involvement in physical training activities to include organized sports and individual fitness. Official guidance from the office of the Dean is that students should spend two hours out of class for every hour spent in class on a particular course. Taken as a goal and not a mandate, the department in which the authors of this study teach, the Department of Civil and Mechanical Engineering, has for some time, implemented a standard practice of surveying students anonymously regarding the amount of time they spend on each course outside of class for each lesson. The data is used in the course development process as guide to balance student requirements for each course. If the previous suggestion is true then it is pertinent to ask what factors influence students in their decisions to allocate that time. This research project is an investigation to discover how in-class experiences influence the amount of time that students dedicate out of class to studying course material. The standard of this research is that 100\% of all lesson objectives are covered during in-class instruction. Is this expecting too little of our students?

The concept for this exploration began with a somewhat arrogant question: “Can an instructor teach too well?” Perhaps a less self-aggrandizing beginning is to explore whether the course material, indicated by course and lesson objectives, is covered during in-class time so thoroughly that it leads students to allocate out-of-class time to other requirements. It is hypothesized that in-class instruction may provide the student a perceived level of comfort in the course material that influences their time-management and perhaps, adversely affects their learning of the material. The focus of this research on student learning is on the short term, but lasting learning would also be likewise affected. No attempt is made to consider what other activities student time is dedicated to. Only affirmative indications of time dedicated to the specific course are considered relevant. Learning is assessed by performance on graded assignments including out of class homework, in-class testing, and student self-assessment.
The study is a relative comparison of data to make inferences as to the correlation of two independent variables, the thoroughness of in-class instruction and student time-management, and one dependent variable, student course performance, or learning as defined above. The results may provide insight to course development practices. Other avenues of research are opened by the method of data collection and the amount and nature of the comparable data that is collected.

We held a basic assumption during the conception and conduct of this research: that time spent dedicated to the course material in study, not necessarily in the completion of homework assignments, is positively correlated to the achievement of high scores on homework assignments and tests. However, it is not believed that meaningful results are predicated on this assumption. Throughout the following discussion, we make references to an hour of instruction during one in-class lesson. The actual time of in-class instruction for students involved in this research is fifty-five minutes per lesson.
METHODOLOGY

Daily surveys are the primary means of data collection. We separated lessons into three categories, regular instruction lessons, homework assignment lessons, and testing lessons. For each category, we designed a survey to capture pertinent data. We provided the surveys to the students at the end of the lesson period. The basic theme of each survey is to gauge the students’ perceptions of their experience over the previous hour of instruction, their experience related to completing a particular homework assignment, or their feelings about performance on an examination that was administered during the previous hour. We developed the surveys with the intent that they would require no more than 2 minutes to complete.

The surveys were not conducted anonymously. Students were asked to provide an ID by which their survey could be identified and eventually tied to homework and test scores. Students were made aware of this at the beginning of the course. We offered the survey as optional participation and made efforts to attempt to not compel students to participate out of fear of reprisal. This is one reason for the ID number on the survey. By not having the students place their name on the survey, it would not immediately be recognizable who completed each survey, putting at least some distance between the student and the data. The lack of anonymity is worthy of consideration in the review of the results of this research.

REGULAR INSTRUCTION LESSONS:

This lesson category represents lessons for which no homework assignments were due and no major testing was conducted. Major testing excludes quizzes lasting less than ten minutes. The survey developed for this lesson category asks three questions, or gains three primary sources of data. Below is a blank sample of the regular instruction lesson survey, the daily survey, or default survey.
**Figure 1. Daily Survey**

The daily survey provides a place for the student to indicate the amount of time that was spent preparing for the upcoming lesson. This data is also used to infer the amount of time spent reviewing material from the previous lesson. An assumption is made here. Time survey data from two consecutive lessons will contain a blend of out-of-class time dedicated to a single lesson, some time in pre-instruction preparation and some time in post-instruction review. The assumption made is that this division of time will balance out over the entirety of the course. We chose to use time spent following a lesson as indicating review of that lesson's material. This is a point of discussion that is addressed in the discussion on continued research.

The first question collects the next set of data, the focus of this research, which is the level of comfort that the student feels toward the instruction that was received in the previous hour. The response is recorded on a scale from zero to ten, with a higher number indicating a greater understanding. We felt that such a scale would give the students greater flexibility and promote an honest reflection by the students regarding their grasp of the material just presented.

The second question is what would be considered the classroom assessment technique known as a minute paper. This question has a couple of purposes. It can be used to indicate a possible discrepancy in the first question. If a student responds to the first question with a response of ten, yet indicates that a topic was unclear, a review of the intent of the survey with the students might have been warranted. It is a check of the system. Responses to this question could be

### XE472 Daily Survey

<table>
<thead>
<tr>
<th>ID#</th>
<th>LSN#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Survey (in minutes):</td>
<td>__________</td>
</tr>
</tbody>
</table>

1) On a scale from 0 to 10, how comfortable are you with the material from today’s class?

<table>
<thead>
<tr>
<th>Not at all</th>
<th>I completely understand</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7 8 9 10</td>
<td></td>
</tr>
</tbody>
</table>

2) What is one topic from today’s class that is still unclear if any?
compared to performance scores and might then be an indicator of further review conducted by the student. For example, if a student indicated that a particular topic was unclear, but scored well on either a homework or test question related to that topic, the student may have conducted further self-study on that topic.

**HOMEWORK ASSIGNMENT LESSONS:**

The homework assignment lesson is one in which a homework assignment is due. An example of the survey used for this lesson category is below.

![Survey Image](image)

**Figure 2. Homework Assignment Lesson Survey**

The intent of this survey is to gain an indication of the self-assessment of the student regarding their time spent in self-study. It can indicate whether or not the student has an awareness of how their self-study time has impacted their ability to complete the homework assignment. It also collects the same data as the daily survey, since instruction is also provided during this type of lesson.

**TESTING LESSONS:**

Testing lessons are those during which an hour long examination is administered. These tests typically cover a six to ten lesson block of material are referred to at USMA as Written Partial Reviews (WPRs). No additional instruction is provided in this type of lesson. A sample of the survey used for this lesson category is below.
Figure 3. Testing Lesson Survey

As with the homework assignment lesson survey the intent of this survey is to gain an indication of the self-assessment of the student regarding their time spent in self-study and could indicate the student’s awareness of how their self-study time has impacted their performance on the WPR.
DATA ANALYSIS

The collection of the data as well as the data input is a tedious time consuming task. The data input over 28 lessons for 35 students amounted to a total of about 8000 entries into the data matrix. The numbers in this form appear random and it is difficult to draw any conclusions. For the purpose of this paper, we chose to look specifically at 3 factors: time spent out of class (TS), perceived comfort level (PCL), and actual performance on graded events (GEs). To analyze the data, we decided to normalize PCL and GEs to a similar scale of 1-100 and then compared these two factors to TS in order to determine any potential correlations between these 3 factors. To maximize visual correlation of the data, we determined that TS should be limited to a scale of 0-250 minutes.

SAMPLE SELECTION:

While inputting the data, we found many incomplete surveys where students failed to fill out one or more entries on their survey. As a result, we chose our samples based on a high level of completeness in data collected. In addition, we were curious to see how grades and performance affect this correlation so we chose samples from students earning A+ through failing grades as of the 28th lesson. Figure 4 shows the resulting data for student 5892, who by lesson 28 had earned a cumulative B-. In assessing this chart, it is important to note that lessons 12 and 20 were compensation time where no class was conducted. Additionally, data was not collected on lesson 24.
From Figure 4, one can observe many things about student 5892. In general, this student is atypical of most other students because he actually spends an average of 1 hour outside of class to learn material on days where there are no graded events due. Most students only work out of class to complete homework assignments or to prepare for tests as supported by the data in Figure 5—the time spent out of class for student 5892’s entire class. Secondly, student 5892’s chart clearly indicates a consistently high PCL after each class. Therefore, it is difficult in this case to determine the effectiveness of teaching as it correlates to PCL as it is undetermined how much of his PCL stems from personal learning. It appears, at least for lesson 7, however, that less study out of class correlated with one of his least understood lessons. It is also interesting to note that after two classes with low PCL he spent the most time out of class of any other day yet still failed the HW4 graded event. This observation could lead to the assumption that this particular student learns more effectively in class than on his own, or it could simply mean that this was a particularly hard learning objective for the student to grasp. Overall, this particular student’s high PCL and above average TS still equated only to average marks on GEs; therefore, it is difficult to observe potential motivation links between PCL and TS in this case.
Figure 5. Class Time Survey Data

Figure 6 is the chart for student 31288. He earned an A grade as of lesson 28. Of note, as in the previous example for lesson 12, 20, and 24 there was no PCL survey taken; however, for all of the other lessons, data was received where he indicated a PCL of 0. In general, this particular student feels as though he often does not understand the material at all as it is presented in class; in fact, his average PCL over the 28 lessons is merely 34%. Despite his lack of understanding in class, he still failed to do much out-of-class personal learning with the exception of completing or preparing for GEs. It is noteworthy, however, to mention that when he did spend time on GEs, he spent copious amounts indeed. Not indicated on the chart due to scale limitation, he reported spending 1020 minutes studying for the 2nd WPR. We observe that this extra time spent on GEs equated to high marks for this particular cadet and can, therefore assume that his primary learning of the material is occurring during large amounts of TS, at least as far as he is concerned. This observation supports the idea that less PCL equates to the perceived need of the student to spend more time out of class to perform well on graded events, and if a high grade is important to that student, this perceived need translates directly into prioritizing time to satisfy the need.
Figure 6. Data for Student 31288
DISCUSSION

Each student’s chart tells a unique story. In establishing these surveys we hoped to ascertain a broad correlation between PCL and time spent out of class. Specifically, we hypothesized that students were spending less time out of class studying when their confidence in the material was high. Looking at a sample of 10 students’ individual charts, the data was inconclusive in direct support of this hypothesis; however, there is a strong trend indicating the opposite is true. Students with low PCL have on average higher TS than those with a high PCL. So a lack of understanding of the material in class does seem to correlate to more time spent outside of the classroom in self-study. Unfortunately, the motivation behind their increased level of TS is inconclusive. This is left open to further investigation. Students show a clear potential to be influenced to dedicate their out-of-class time to individual study. If the most significant learning in a student’s collegiate career takes place outside of the classroom, then continued work is warranted to decipher what actions can be taken by the instructor to optimize this time spent. For certain, work has already been conducted in the area of motivating students to dedicate out-of-class time to studying course material. One interesting study offered a motivation to the students that they were able to use the products of their self-study during examinations. Of particular interest related to our data collection methods may be to discover what percentage of lesson objectives, or percentage of course material, should be left to self-study by the student. Is there an optimal range?
FUTURE RESEARCH

The greatest value of this classroom research project stems from the experience gained in collecting the data and the potential for further, more formal research as represented by the method of data collection and the type of data collected. The analysis of the data in this study is a simple relative comparison. Graphical representation of the data was the means used to draw inferences and conclusions. We employed a non-statistical method of analysis. Our intent is to continue this approach with a more thorough experimental design approach. The data collection method represented in this research project could be well fitted to a single factor analysis of variance experiment or a factorial design experiment. These experiments would produce data potentially fitted to a model that provides meaningful statistical results. We have discussed many possible tests to conduct based on the factors collected in this daily survey method. These factors, in turn, could produce a wealth of data points.

There are a few things to highlight regarding our research project that may be worthy of consideration for review or correcting in future research: the lack of anonymity of data collection, a potential to develop negative rapport through the lack of response to minute paper results, and the non-statistical means of analysis.

To infer correlations of our data, we felt it necessary to be able to tie responses to performance scores. This meant we needed to tie names to our data and thereby eliminate anonymity. The cautions associated with collecting non-anonymous data are many. We gave great consideration to this when developing the project, knowing that our position of instructor, and grader, was tenuous when asking for data related to time spent on learning course material. Among our safeguards was to use the ID number approach to provide some distance between response and student. The instructor would not be able to immediately identify responses, and we only did so for the purpose of this paper. Surveys were collected by the students into a group and then left for the instructor to collect after students departed the classroom. We relied heavily on trust, asking the students to trust that we would not use the data in any way against them in regards to their scores.

Even though the survey was not made mandatory, there is likely to be concern among students if many participate, but few do not. Students may feel pressure to participate meaning
the survey results are potentially biased and inaccurate. Students may respond according to what they believe the instructor wants to see.

In the daily survey, the second question asks students to indicate which topics are unclear. This “minute paper” technique is widely employed in our department as a classroom assessment technique. This survey question highlights a potential drawback of this study, which is that any review of these “unclear” topics by the instructor in subsequent lessons could skew the results. Review of material from previous lessons in class could establish an expectation among the students that self-study was unnecessary because the instructor would just review material in-class, creating even more reason to not spend time in self-study. Further, the instructor not reviewing the topics indicated as “unclear” has the potential to create negative rapport with the students.

Finally, in future research, we intend to establish, from the outset, a more statistically reliable data set, which could be model fitted to determine correlation between factors and output. For example, we are interested in determining whether covering only a certain percentage of lesson objectives during in-class time affects dedicated out of class time. If the instructor highlights all of the lesson objectives, and indicates which of those are going to be covered in class and which are to be left to the student to learn on their own, would this have a direct impact on how much time students do study on their own. This would be a single factor study. A $2^k$ factorial design might examine the affects of both percentage of lesson material covered in class and self-study time to performance. Any statistically relevant experiment would need to be truly randomized. Great preparation will be needed during course development to ensure randomization of all factors. And still, given our students’ many competing demands, a great deal of experimental noise will remain.

At its heart, our research is centered on the question of whether expecting more of students will translate to more dedicating of out-of-class time by the students. If a teacher’s goal is truly to provide the student with significant learning of their course material, is he or she in jeopardy of contradicting that goal by covering the course material to too great of an extent in class? To what extent will students reasonably, given all of the demands placed on them, devote their out-of-class time to furthering their education in self-study?


