AC 2010-2191: EFFECTIVENESS OF TEXTBOOK AND OUTSIDE SOURCES IN TEACHING ENGINEERING ECONOMICS

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Abstract

The paper will discuss changes made in the teaching of Engineering Economics, a required sophomore undergraduate class. The first change was the inclusion of relevant economic and financial news to complement subject matter covered in class. This new material covered approximately 25% of the required contact hours and allowed the course to be used to assess two ABET criteria.

The second and more significant change was that while the course outline was left intact, the textbook required in previous years was no longer required. At the end of the semester, the class of over 50 students was surveyed on the consequence of not requiring a textbook. The textbook required in prior years was provided as a reference and the course sequence closely followed that of the textbook without the use of the actual examples and homework assignments from the book. Therefore students interested in having the textbook as a reference were able to do so.

The paper will summarize the results of the survey and conclusions will be drawn on the necessity of requiring a textbook for teaching Engineering Economics.
Background

While textbooks are often incredibly valuable especially at the undergraduate level and textbook authors are seriously under-compensated, it is worth examining the value of textbooks in specific classes. The usefulness of a textbook will vary depending on how the course is taught, the nature of the instructor, student body, outcomes, etc. Faculty also need to be aware of the marketing strategy increasingly used by publishers that involve marginally altered new editions of existing textbooks to defeat the used textbook market.

The survey was administered immediately before the 3rd exam and after the 1st and the 2nd exams were graded and returned to the students. Therefore, with approximately 60% of the grades accounted for, the students had a good sense of their expected grades and performance in the course.

Since the survey was anonymous, correlating the response to the grade a student obtained in the class was beyond the scope of the survey. Ensuring anonymity was deemed more important to ensure honest response while losing the ability to correlate response more specifically to a student’s grade. During the semester when the survey was conducted, the average grade for the class was 81.3 (out of 100) while the standard deviation was 15.7. The same class taught with a required textbook in the previous year had an average grade of 77.5, with a standard deviation of 18.6. While intuitively one may think that not having a textbook would lower grades and increase the standard deviation, the opposite seems to be true, although not in any statistically significant way.

Description of the Course

The course is required for all Civil and Mechanical Engineering students and an elective for students in Electrical and Computer Engineering. The class consisted of students from all of these departments. An in-depth description of the course is beyond the scope of this paper. Therefore this section will attempt to discuss those questions that are likely to arise in interpreting the conclusions, understanding its limitations and avoiding generalizations. A textbook can always add value to a classroom especially if it is used to augment classroom instruction material. Alternately, additional material can often be provided via the web to augment or to supplement prescribed assignments from a textbook.

The course being discussed was specifically altered to deemphasize the content of the textbook and supplement it with broader reading assignments (hard or soft copies) and associated discussions from the media (local newspapers, Wall Street Journal, Economist, websites). The lectures every Friday was dedicated to these readings and discussions. Examples of such readings are the following:

Cost-benefit analysis of Higher Education
US Treasury’s rescue package for the banking sector
Economic outlook for New Mexico
Construction cost, commodities market
Credit-default Swaps; self-interest and failure of oversight
Conflict of interest in the healthcare sector
How to launch a business in your 20s
Comparative analysis of various world economies
Cost of energy, renewable energy and carbon trading
National debt, foreign exchange rates and international trade

This allowed the course to be used to assess two of the Outcomes prescribed by ABET:

ABET Criterion f: An understanding of the professional and ethical responsibility.
ABET Criterion h: The broad education necessary to understand the impact of engineering solutions in a global/societal context.

One major use of the textbook in this class is the availability of interest rate tables. Students were given a few tables as handouts in the 1st week of class. Once the relevant equations were discussed in weeks 2 and 3, the students were asked to generate their own interest rate tables for a specific set of interest rates for quick reference and program the formulae in their calculators. The students were also asked to do three assignments on Excel using the financial functions to force them to do work larger problems. One of these problems was to develop the 30-year home mortgage payment table and determine the cost-effectiveness of refinancing a home mortgage at any given point in time.

Due to the large number of students, it was not possible to allow individuals to work out problems on the board. Homework problems developed by the instructor to reflect the material covered in class was assigned every week. In the absence of a textbook, students did not have the opportunity to work additional problems. There were three exams administered in the class. Exams and solutions from previous years were distributed to give students the opportunity to practice and evaluate their level of preparedness. All exams were open notes and open book (to those who chose to buy it). Students were made aware in the beginning that those who chose to buy the textbook will be allowed to use it during the exams.

Survey Questions, Results and Analyses

The description of the survey, the 8 questions asked and possible answers are detailed below.

The students were asked:
“Please take 5-minutes to answer the following. It will help future students (and me). If you bought the textbook anyway, skip to question #3. Please circle the most appropriate answer.”

The response to each question has been tabulated below the question, followed by an analysis of the result. Students were also allowed to provide additional comments if they wished to do so.

Question #1. Requiring a textbook would have helped you learn better.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>15</td>
<td>26</td>
<td>10</td>
</tr>
</tbody>
</table>
Most students 36 (=26+10) thought that a textbook would not have helped them learn better as opposed to 17 (=2+15) students who thought a textbook would have helped.

**Question #2.** Not having a textbook forced you to concentrate more in the class and take notes.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>17</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

There is almost unanimous agreement (with 1 exception) on this question that not having the textbook forced more concentration and active role in class. Almost 2/3 of the class agreed very strongly that not having a textbook increased class participation. This view was also dominant in the comments received from the students.

**Question #3.** The cost of buying a textbook (about $120) outweighs the potential benefits.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>22</td>
<td>14</td>
<td>4</td>
</tr>
</tbody>
</table>

Most students thought that the cost of the textbook outweighs the benefit. This should be used with caution since the value of a textbook depends significantly on the type of course, instructor, maturity of students etc.

**Question #4.** Answer this question only if you bought the textbook anyway. Having the textbook helped you learn more and get a better grade.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2</td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>

Only 8 students had chosen to buy (or borrow) the textbook and ¾ of them disagreed that having the book helped them learn more or improve their grades.

**Question #5.** Other regular commitments (work, family etc.) affect your ability to attend all lectures.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>17</td>
<td>24</td>
<td>10</td>
</tr>
</tbody>
</table>

A few students 19 (=2+17) indicated difficulties in attending classes, but most students 34 (=24+10) indicated that this is not an issue. It needs to be pointed out in this context that the University of New Mexico student body is ethnically diverse (half are minority students), in an urban setting where most students commute. Many of the undergraduate students are married with family and work commitments outside of their educational commitments.
Question #6. Cost of textbooks is not important to you since it is a small fraction of the total cost of education and/or paid from scholarships/reimbursable educational savings account, employer/parent, etc.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>12</td>
<td>19</td>
<td>18</td>
</tr>
</tbody>
</table>

More (over 2/3) students (37 = 19+18) cited the cost of textbook to be an issue than those for whom this was not an issue (16 = 4+12). A significant number of students cited the cost to be a major issue.

7. You usually buy textbooks through:

<table>
<thead>
<tr>
<th>New-UNM Bookstore</th>
<th>Used – UNM or outside</th>
<th>Online</th>
<th>Other Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>19</td>
<td>14</td>
<td>0</td>
</tr>
</tbody>
</table>

The purchase of textbooks seems to be split evenly between the first three categories. Over 2/3 of the purchase is still with the university bookstore. None cited ‘other source’ which could include outside used book-stores, friends, etc. Only 14 out of 53 reported buying textbooks online in spite the lower cost typically associated with online purchases. This may be attributable to lack of timely delivery for online orders, logistical advantage of university bookstore such as buying everything at once, ability to use financial aid, etc.

8. What is your GPA in your degree program?

<table>
<thead>
<tr>
<th>&gt;3.5</th>
<th>3.0-3.49</th>
<th>2.5-2.99</th>
<th>&lt;2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>30</td>
<td>9</td>
<td>0</td>
</tr>
</tbody>
</table>

The goal of this question was not to find out about GPAs, but to seek correlation between GPA and answers to previous questions. Predominant GPA was between 3.0 and 3.5; none reported a GPA less than 2.5. This could be attributable to admission standards into the engineering degree programs at the University of New Mexico.

Correlation between GPA and response to other Questions

Of the 14 students who had a GPA > 3.5, the response to Question 1 (Requiring a textbook would have helped you learn better) were the following:

Strongly Agree = 1
Agree = 3
Disagree = 7
Strongly Disagree = 3

Of the 9 students who had a GPA between 2.5 and 2.99, the response to Question 1 (Requiring a textbook would have helped you learn better) were the following:

Strongly Agree = 1
Agree = 2
Disagree = 6
Strongly Disagree = 0

It is inconclusive whether or not good (>3.5GPA) or mediocre (2.5-2.99 GPA) students have greater need or apathy for textbooks.

Of the 14 students who had a GPA > 3.5, the responses to Question 2 (Not having a textbook forced you to concentrate more in the class and take notes) were the following (1 no response):
Strongly Agree = 8
Agree = 4
Disagree = 1
Strongly Disagree = 0

Of the 9 students who had a GPA between 2.5 and 2.99, the response to Question 1 (Requiring a textbook would have helped you learn better) were the following:
Strongly Agree = 5
Agree = 4
Disagree = 0
Strongly Disagree = 0

Both good and mediocre students indicated more active use of class time. There seems to be a stronger agreement on this from the mediocre students than the good students.

Of the 8 students who bought the textbook, answer to question #6 (Cost of textbooks is not important to you…) was the following:
Strongly Agree = 0
Agree = 2
Disagree = 2
Strongly Disagree = 4

The interesting observation here is that the very few that chose to buy the textbook indicated in general that the cost of textbook is a factor; but they chose to buy it in spite of that.

**Conclusion**

Each course is unique and a function of institutional factors. However, it is worth revisiting the premise that the textbook is an essential tool for better education. In this specific instance, not requiring a textbook, as had been the norm in this Sophomore-level Engineering Economy course, was well received by the students. This was partly due to the course content being altered to include broader sources of information on current topics, hence limiting the amount of time dedicated to the material from a textbook.
While cost of textbooks is a factor, not having a textbook leads to greater engagement in class for all. This is perhaps more true for the mediocre students. The need or apathy for a textbook for good students was not distinguishable from that of mediocre students. Students who bought the textbook included those who consider cost of textbooks to be significant as well as those who do not. The students’ grades or spread among students did not deteriorate as a consequence of not requiring a textbook. Other student attributes reported in this paper could be helpful for undergraduate instruction in general.