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Online Testing to Assess Performance of Students in a Large Engineering Class

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Online Testing to Assess Performance of Students in a Large Engineering Class

Abstract
Fall 2017: Engineering Economic Analysis course •242 students: in-class and distance learning •New assessment procedure: Online testing modules •7 required online testing modules •2 bonus testing modules to earn an A •Semester grades determined completely by number of modules passed •Unlimited number of attempts for each testing module •Randomly chosen questions

Disciplines
Industrial Engineering | Manufacturing | Other Operations Research, Systems Engineering and Industrial Engineering | Systems Engineering

Comments
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Online Testing to Assess Performance of Students in a Large Engineering Class

Vrishtee Rane, Graduate Student
Cameron MacKenzie, Assistant Professor
Motivation

Potential solution:
Online assessments with multiple attempts
Fall 2017

- Engineering Economic Analysis course
- 242 students: in-class and distance learning
- New assessment procedure: Online testing modules
  - 7 required online testing modules
  - 2 bonus testing modules to earn an A
- Semester grades determined completely by number of modules passed
- Unlimited number of attempts for each testing module
- Randomly chosen questions
Randomly Chosen Questions

Transportation (TM)

- i
- ii
- iii
- iv
- v
- vi
- vii

- A
- B
- C
- D

1
2

100
Example Question from Testing Module 4

**TM4: Question i: Problem A: 1**

Consider the financial data for the following project. The annual revenue and annual expenses occur at the end of years 1 through 6 and the salvage value is recouped at the end of the 6 years.

- Initial investment: $109,000
- Annual revenue: $31,000
- Annual expenses: $8,000
- Salvage value: $12,000
- Project life (years): 6

What is the IRR for this project?
Passing Testing Modules

- Calculation questions: Excel spreadsheets, Monte Carlo simulation
- Questions required numerical answer (allowed for rounding error, ± 1% of correct answer)
- One question could be answered incorrectly
Research Questions

1. Do students prefer online testing over in-class testing?
2. Does the students’ performance improve with multiple attempts of online tests?
3. Do students perform better in online tests?
Question 1: Do Students Prefer Online Testing over In-class Testing?

- Two surveys: mid-semester and end of the semester
- Survey questions
  - Anxiety
  - Preference
  - Engagement
  - Motivation to learn
  - Deadlines for modules
## Survey Results

<table>
<thead>
<tr>
<th></th>
<th>Anxious during in-class exam</th>
<th>Anxious during online exam</th>
<th>Engagement in course with online test</th>
<th>Prefer online testing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total respondents</strong></td>
<td>(235)</td>
<td>(235)</td>
<td>(233)</td>
<td>(233)</td>
</tr>
<tr>
<td>1. Strongly Agree</td>
<td>37</td>
<td>3</td>
<td>16</td>
<td>37</td>
</tr>
<tr>
<td>2. Agree</td>
<td>43</td>
<td>8</td>
<td>24</td>
<td>35</td>
</tr>
<tr>
<td>3. Neither agree nor disagree</td>
<td>11</td>
<td>16</td>
<td>31</td>
<td>15</td>
</tr>
<tr>
<td>4. Disagree</td>
<td>7</td>
<td>49</td>
<td>19</td>
<td>7</td>
</tr>
<tr>
<td>5. Strongly disagree</td>
<td>1</td>
<td>24</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

*Industrial and Manufacturing Systems Engineering*
# Survey Results

<table>
<thead>
<tr>
<th></th>
<th>Learned the material better</th>
<th>Motivation to pass bonus testing modules for an A</th>
<th>Requirement of deadlines</th>
<th>Recommend online tests for other courses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(233)</td>
<td>(233)</td>
<td>(233)</td>
<td>(233)</td>
</tr>
<tr>
<td>1. Strongly Agree</td>
<td>17</td>
<td>49</td>
<td>24</td>
<td>21</td>
</tr>
<tr>
<td>2. Agree</td>
<td>31</td>
<td>19</td>
<td>40</td>
<td>34</td>
</tr>
<tr>
<td>3. Neither agree nor disagree</td>
<td>27</td>
<td>17</td>
<td>19</td>
<td>25</td>
</tr>
<tr>
<td>4. Disagree</td>
<td>27</td>
<td>9</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>5. Strongly disagree</td>
<td>8</td>
<td>5</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>
Feedback from Students

- I enjoyed how the modules were set up in place of regular tests and exams. I also liked that there wasn't a deadline for the modules, so you could complete them at your own pace. I thought this also added an additional challenge to the course of learning how to pace yourself and becoming responsible for meeting your own deadlines. I think this is a very important life skill that often isn't taught, so it was nice to have that responsibility in this course.

- The online modules used for the class were very effective (although difficult at times) and truly made each student learn the content due to repetitive practice.

- Online testing modules are frustrating and are the only reason why I would not recommend this class.
Feedback from Students

- **Loved** how the class was gone with having no in class exams. But still having required testing modules was great, because I was able to do them when I wanted to and **didn't have the extra pressure or stress** added to them.

- I am very **disappointed** in the online modules. This class was essentially an online course, which is not what I signed up for. Instead of in class exams with partial credit and required studying, the online modules are a cheap and **ineffective form of learning**. Students cheat with each other and use the internet to look up answers with **no learning involved**. In summary, the online modules failed me in terms of actually learning about engineering economics.
Question 2: Does the Students’ Performance Improve with Multiple Attempts?

- More than one attempt to pass
- Each new attempt → more students passed
- Some students attempted the testing modules (TM) more than 15 times
## Students’ Success Rate

<table>
<thead>
<tr>
<th>Testing module</th>
<th>Topics</th>
<th>% of students passed in final attempt</th>
</tr>
</thead>
<tbody>
<tr>
<td>TM1</td>
<td>Interest rates, economic equivalence</td>
<td>95</td>
</tr>
<tr>
<td>TM2</td>
<td>Non-annual compounding, debt repayment</td>
<td>95</td>
</tr>
<tr>
<td>TM3</td>
<td>Present-worth analysis, annual-equivalent worth</td>
<td>89</td>
</tr>
<tr>
<td>TM4</td>
<td>Rate of return, cost concepts</td>
<td>95</td>
</tr>
<tr>
<td>TM5</td>
<td>Project cash flow, depreciation, taxes</td>
<td>92</td>
</tr>
<tr>
<td>TM6</td>
<td>Inflation</td>
<td>88</td>
</tr>
<tr>
<td>TM7</td>
<td>Uncertainty, simulation, risk</td>
<td>73</td>
</tr>
</tbody>
</table>
Percentage of Students Who Pass a Testing Module per Attempt

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Industrial and Manufacturing Systems Engineering
Cumulative Percentage of Students Passing Testing Modules per Attempt

- TM1
- TM2
- TM3
- TM4
- TM5
- TM6
- TM7
- Average

Percentage of Students

Attempts

0 10 20 30 40 50 60 70 80 90 100

1 2 3 4 5 6 7 8 9 10

Slow growth

10%

Difficult TM7
Question 3: Do Students Perform Better on Online Tests?

- Compared performance of Fall 2017 (online testing modules) with Spring 2017 (traditional assessments)
- Spring 2017 Engineering Economics Analysis
  - 163 students
  - 8 homework assignments
  - 1 group project
  - 3 in-class exams (50 minutes each)
  - 1 online final exam
Comparison between Online Testing Modules and Traditional Exams and Homework

Percentage of Students

Grades

A: 52%
A-: 7%
B+: B-
B: C-
C+: C
C
D+ D
D- F

Traditional Assessment
Online Testing Modules
Online Testing Modules with Multiple Attempts

**Pros**
- Flexibility
- Learning through repetition
- Use of computers
- Complex practical examples
- Instant results
- Distance learning

**Cons**
- Frustrating at times
- Deadlines to meet at the end of the semester
- E-cheating
Conclusion

• Do students prefer online testing over in-class testing?

  72% of students prefer online testing

• Does the performance improve with multiple attempts of online tests?

  Average of 10% of students pass on each attempt

• Do students perform better on online tests?

  52% of students earned an A or A-
  7% failed course
Acknowledgement

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