TEACHING INTRO STATISTICS TO NON-STEM LEARNERS: A DATA DRIVEN COURSE REDESIGN EXPERIENCE

NIMET ALPAY, PhD
TPAC, FRANKLIN UNIVERSITY
JUNE 3RD, 2015
OUTLINE

• **PART I:** An overview of an introductory statistics course with course content

• **PART II:** Intro stats at Franklin

• **PART III:** A data driven course redesign

• **PART IV:** Results

• **PART V:** Future plans and suggestions
What is statistics?
Statistics is the science of learning from data.
As a discipline....
WHY????

• Improve quantitative thinking skills – ask the right questions, find ways to answers, draw conclusions and interpret

• Make sense of the piles of data

• Make informed decisions – don’t rely on others to make the decisions for you

• Live an informed and well-planned life – forecasts, medical practices, political campaigns, consumer goods, insurance, etc…

• The “hottest skill” that got people hired in 2014 is

STATISTICAL ANALYSIS
COURSE CONTENT

- **Descriptive Statistics**
  - Sampling methods
  - Classification of Variables
  - Experiments vs surveys
  - Graphical and Tabular Displays
  - Measures of Center, Measures of Spread

- **Principles of Probability**
  - Simple probability
  - Conditional probability with two way tables

- **Probability Models**
  - Discrete, Binomial, Normal

- **Central Limit Theorem**
  - Law of Large Numbers
  - Sampling distributions
COURSE CONTENT

- **Estimation – Confidence Intervals**
  - Point Estimates
  - Margin of Error
  - Confidence Level

- **Hypothesis Testing**
  - Hypotheses
  - Test Statistic and Critical Region
  - Level of Significance, P-values
  - Hypothesis Testing from two Samples – Paired samples
  - Hypothesis Testing for Qualitative Data

- **Correlation and Regression**
  - Bi-variate data
  - Correlation does not mean causation
  - Least Squares Regression Line
  - Predictions
PART II: INTRO STATS COURSE AT FRANKLIN

- MATH 215 – STATISTICAL CONCEPTS
  - Gateway course
  - Historically had high drop out rates – more with online sections
  - Historically had student survey responses that are very negative
  - Too much content – not enough time for conceptual understanding
  - Inconsistencies between different components of the course
  - Lack of instructor training – observations
  - Overwhelming work load for Franklin students
HIGH DEWZ & ATTRITION RATES

MATH 215 Student Performance – Fall 2013

Overall Performance
- DEWZ Students: 49.85%
- Passing Students: 50.15%

Face-to-Face Classes
- DEWZ Students: 57.01%
- Passing Students: 42.99%

Online Classes
- DEWZ Students: 46.75%
- Passing Students: 53.25%

Fall 2013 Attrition Rate: 26.11%
FRANKLIN UNIVERSITY STUDENT SUCCESS INITIATIVE

STUDENT SUCCESS INITIATIVE GOAL:
TO INCREASE

Student Retention  Performance  Graduation Rates
PART III: A DATA DRIVEN COURSE REDESIGN

OUR REDESIGN GOALS: Increase

• student retention
• student success (i.e. percent of students receiving passing grades of A, B, and C)
• depth of student learning
• problem solving skills
• instructional support for online students whose time schedules prevent them from attending synchronous online sessions.
DATA SOURCES FOR THE REDESIGN

• Student Course Surveys (Ratings and comments)
• DEWZ and Performance Rates
• Program chair’s feedback
• Instructors feedback
• SLC feedback
• Statistics Task Force Report
OTHER RESOURCES TO INFORM THE REDESIGN

• GAISE STANDARDS
• OBR REQUIREMENTS
• BEST PRACTICES
GUIDELINES FOR ASSESSMENT AND
INSTRUCTION IN STATISTICS EDUCATION (GAISE)

• Emphasize statistical literacy and develop statistical thinking;
• Use real data; (and relevant)
• Stress conceptual understanding rather than mere knowledge of procedures;
• Foster active learning in the classroom;
• Use technology for developing conceptual understanding and analyzing data;
• Use assessments to improve and evaluate student learning;
FACTORS IMPACTING STUDENT RETENTION AT THE COURSE LEVEL

Effective Instruction

Effective Course Design

IMPACT

Student Retention & Success
Pedagogical Knowledge (PK)

Content Knowledge (CK)

Pedagogical Content Knowledge (PCK)

Pedagogical Knowledge: Knowledge of how to teach & how to teach online

Content Knowledge: Knowledge of the course content

Pedagogical Content Knowledge:
- Knowledge of “how subject matter is organized, adapted, and represented for instruction” (Shulman, 1986, p. 1021)
- Knowledge of how to teach introductory statistics to adult students
INSTRUCTOR OBSERVATIONS

• A uniform observation form is used.
• Observation is done on a day when a new topic is introduced.
• Instructor is informed about the observation and the form ahead of time.
• At least an hour of observation is completed for each instructor.
• Follow up: written feedback is provided emphasizing the strengths and areas to improve. If there is too much concern about an instructor, 1:1 meeting is done and re-observed next term.
• It is very valuable but it takes quite a lot of time.....
SYSTEMATIC INSTRUCTION – INTERACTIVE MULTIMEDIA LECTURES

• Created 28 interactive multimedia lectures to help students understand different statistical concepts quicker.

• The lectures include the following components:
  • New information delivery
    • Includes examples
    • Includes both visual and auditory information
  • Information summary
  • “Check your learning” comprehension questions
    • Multiple choice
    • Drag and drop
    • Fill in the blank
TEXTBOOK CHANGE

  ❖ REPRESENTATIVE STUDENT COMMENT ABOUT THE OLD TEXTBOOK
    • Extremely confusing textbook.
    • Very hard to understand.

  ❖ REPRESENTATIVE STUDENT COMMENT ABOUT THE NEW TEXTBOOK
    • Textbook is very easy to understand.
    • I liked the book a lot as it broke down the concepts in a clear and concise manner.
WEB-BASED COMPONENT CHANGE

- SMARTBOOK - ADAPTIVE LEARNING TECHNOLOGY
- CONNECTMATH – ASSIGNMENT AND ASSESSMENT
  Platform with integrated media-rich e-book
WEEKLY ASSIGNMENT AND ASSESSMENT TYPES

Week 3
Contains 6 Objects
With 45 Points
Taking 7 Hours

- Week 3: Weekly Preparation
- Interactive Lecture for Module 3
- Week 3 ConnectMath Assignment
- Week 3 Group Assignment
- Week 3: Application Assignment
- Start - Part 1 Data Analysis & Inference
PART IV: RESULTS
DATA COLLECTION INSTRUMENTS

Attrition & Performance Data
- Course evaluation
- Multimodal evaluation

Evaluations
- Course evaluation
- Multimedia evaluation

Instructor Feedback
- Course design feedback
- Multimedia feedback

Academic Support Services
- Attendance Rates

Triangulation
RESULTS DEWZ & ATTRITION RATES

MATH 215 Student Performance – Fall 2014

Overall Performance
- DEWZ Students: 35.29%
- Passing Students: 64.71%

Face-to-Face Classes
- DEWZ Students: 36.49%
- Passing Students: 63.51%

Online Classes
- DEWZ Students: 33.93%
- Passing Students: 66.07%

Fall 2014 Attrition Rate: 14.31%
RESULTS: COMPARISON OF DEWZ AND ATTRITION RATES

FA13 & FA14 Comparison of Course Rates
RESULTS: STUDENT PERFORMANCE RATES

<table>
<thead>
<tr>
<th></th>
<th>FALL 13</th>
<th>FALL 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total # of Students</td>
<td>335</td>
<td>255</td>
</tr>
<tr>
<td>Online Students</td>
<td>221 (66%)</td>
<td>127 (50%)</td>
</tr>
<tr>
<td>FF Students</td>
<td>114 (34%)</td>
<td>128 (50%)</td>
</tr>
<tr>
<td>Grade A</td>
<td>12.2%</td>
<td>21.2%</td>
</tr>
<tr>
<td>Grades: A – C</td>
<td>49.8%</td>
<td>64.3%</td>
</tr>
<tr>
<td>Grades: D &amp; Below</td>
<td>50.2%</td>
<td>35.6%</td>
</tr>
<tr>
<td>Attrition Rates</td>
<td>26.11%</td>
<td>14.31%</td>
</tr>
</tbody>
</table>
## CONTINUING EFFECT OF COURSE REDESIGN

<table>
<thead>
<tr>
<th></th>
<th>FALL 13</th>
<th>FALL 14</th>
<th>WINTER 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total # of Students</td>
<td>335</td>
<td>255</td>
<td>279</td>
</tr>
<tr>
<td>Online Students</td>
<td>221 (66%)</td>
<td>127 (50%)</td>
<td>170 (61%)</td>
</tr>
<tr>
<td>FF Students</td>
<td>114 (34%)</td>
<td>128 (50%)</td>
<td>109 (39%)</td>
</tr>
<tr>
<td>Grade A</td>
<td>12.2%</td>
<td>21.2%</td>
<td>19.4%</td>
</tr>
<tr>
<td>Grades: A – C</td>
<td>49.8%</td>
<td>64.3%</td>
<td>66.7%</td>
</tr>
<tr>
<td>Grades: D &amp; Below</td>
<td>50.2%</td>
<td>35.6%</td>
<td>33.3%</td>
</tr>
<tr>
<td>Attrition Rates</td>
<td>26.11%</td>
<td>14.31%</td>
<td>10.8%</td>
</tr>
</tbody>
</table>
I wanted to take a moment and thank you for everything you have done for me this past semester. If you could have only seen me and the anxiety I had about this class 6 months ago, it would have almost been comical. I waited until I was a senior with 2 HR classes to go before I took stats. I **NEVER thought I would finish this class with a decent grade and actually understanding so much of it.**

-Tina

I felt pretty good taking the test and am pleased with my final score! I must say that I **am extremely impressed with the way Franklin does this class. I know Statistics is typically a universally feared class, but it hasn’t been too bad so far.**

-Brandon

I enjoyed the class even with all of the work. Near the end, everything has fit together and it all makes sense. I have a better understanding of how this type of math helps businesses. All of the information from this class will help me with my future business.

-Dianne
PART V: FUTURE PLANS

- Multimedia research project – started but need funding
- Continuous improvement of the course for each term
- Turning all the tests online
- Continue instructor training and professional development
- Offering **Math 115: Intro to Quantitative Reasoning** as a pre-requisite for Non-STEM learners
A FEW POINTS OF CONSIDERATION...

- **Productive struggle** to promote learning
- Active learning through in-class activities, interactive multimedia, discussion board activities
- Motivation first, explanation later
- Use technology for computations and emphasize on interpretations
- Use real but relevant data
- Have fun....
KEEP CALM AND LOVE STATISTICS

THANK YOU!