Measuring the Effectiveness of Online Learning Resources

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COURSE PROJECT

Final Due Date: 23-11-2023
Late submissions will not be accepted.

All undersigned students have made a significant contribution to this project:

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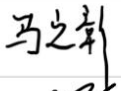
Zhizhang Ma	1005952426	
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Group Members who do not sign this sheet receive a mark of zero.

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Introduction

With COVID-19 diminishing and universities reopening to offer lectures in person, courses might choose to stop certain practices such as lecture recordings. However, such practices can be an important part of the toolkit for students' learning. This study will examine the impact of using online resources during the duration of a course and a student's self-reported academic satisfaction. In general, online resources pertain to a specific course providing additional resources to supplement learning from traditional lectures that are accessed over the web. These resources include recordings of lectures and/or tutorials, having a Piazza forum, annotated slides, and past tests or exams. Understanding how online resources can impact learning will be important as universities return to normalcy.

Description of Variables

The variables are designed to split into two sections in order to identify participants' identity and to estimate the satisfaction and self-rated impact from all kinds of online or offline resources. **Gender** and **Student Origin** are used to describe the identity of the participant. Specifically, Student Origin describes whether the participant is an international student or a domestic student. This is easy for us to further determine whether or not coming from Canada may play a role in efficiency of online studies.

Since asking for marks is not allowed, a more manageable subjective approach is suggested, by taking **Academic Satisfaction** as a predictor variable, from 1 to be very dissatisfied and 5 as very satisfied. We divided the rest and came up with variables that represent materials from the course. **Recording Impact** measures subjective impact on how lecture recording helps in studying. **Annotate Impact** measures subjective impact on how annotated lecture slides and tutorial notes help on studying. Same with **Piazza Impact**, which measures subjective impact on how discussion forums like piazza improves learning performance.

There are also **Mode of Learning**, **Pre Study**, **Post Learning** and **Online Understanding** for determining the learning style of the participant. Basically, **Pre Study**, **Post Learning** suggests the main resources of how the participant gains knowledge of course content during before lecture and after lecture; **Online Understanding** measures a subjective idea of how the participant thinks about resources they gain before and after lecture actually help them with course content.

As shown, the variables are separated into identification, academic satisfaction scores and resource-serving variables, with only academic satisfaction scores (including Online Understanding) being quantitative variables, while others are all categorical variables.

Sample Size

For our data collection model, we used simple random sampling (SRS) using a survey. We posted our questionnaire to the STA304 Piazza Discussion Board where every student had the ability to participate in the survey. This ensured all students had an equal chance to provide an answer, and in turn collected data from their responses.

To find our required sample size, we are using the formula below. In this formula, n = the sample size required for our sample (what we are calculating), N = the population of UTM students currently enrolled in STA304H5 F 2023, We are using an estimate of N = 200. p = the proportion of students who use online learning resources, since this value was unknown to us at the time of developing our survey, we are using the generalized value p = 0.5. Since we are estimating the sample size, estimation comes with error, there we bound the error by using variable B. We fixed B = 0.1685.

$$n = \frac{Npq}{(N-1)\frac{B^2}{4} + pq} = \frac{200(0.5)(0.5)}{(200-1)\frac{0.1685^2}{4} + (0.5)(0.5)} = \frac{50}{199(0.0071) + 0.25} = \frac{50}{1.6625} \approx 30$$

We get a value of 30 for n. Since our sample size is above 30, we are confident that we have the required sample size.

Results

We wanted to investigate the association between learning modes and academic satisfaction. Where Group 1 is Engagement-study with Online Learning Resources (OLR) and Group 2 is Engagement-Study only. Since our sample is not normally distributed, we used the Mann-Whitney U test.

In order to test if there is a significance association, we used the U-test to determine if there is a difference in academic satisfaction between group 1 and 2. Our U-test results concluded with a 95% certainty that engagement groups with online learning resources and engagement-study-only groups have no difference in terms of their academic satisfaction.

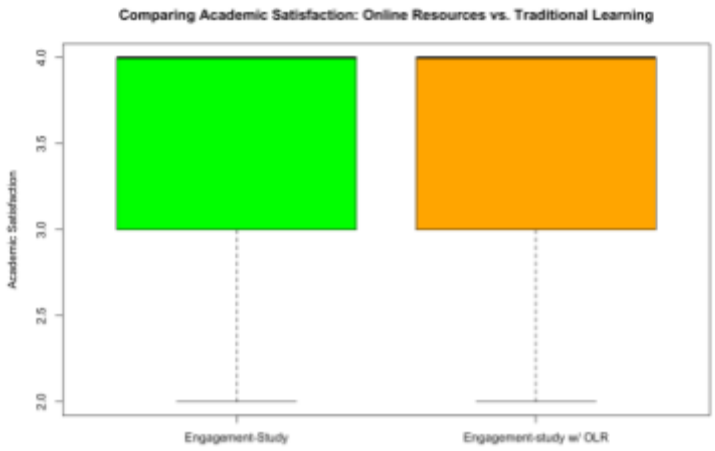

Figure 1: Academic Satisfaction of Engagement-Study vs. Engagement-Study with OLR

Figure 1) This box graph was created from our data set. It shows the distribution of academic satisfaction of group 1 (engagement-study) in green, and group 2 (engagement-study w/OLR), in orange. Both group 1 and group 2 seem to have similar distributions, having academic satisfaction values between 3.0 and 4.0.

We also wanted to determine if there is a relationship between "Professor Edited Materials" and academic satisfaction. These materials encompass Annotated Lecture Slides/Tutorial Notes, Lecture/Zoom Recordings, and Piazza/Discussion Forums. We define these materials as our independent variables, while we define academic satisfaction as our dependent variable. We conducted a Multiple Linear Regression analysis on the data, in which we computed coefficient values, plotted below:

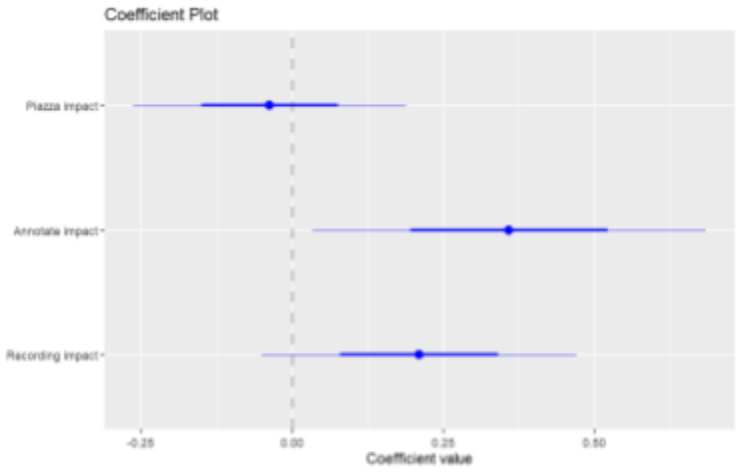

Figure 2: Coefficients of "Professor Edited Material" on Academic Satisfaction

Figure 2) This coefficient plot created from our results, shows the distribution of annotate impact, piazza impact, and recording impact based on their coefficient value. We interpret the coefficient value as indicating the effect of the material on academic satisfaction. Further, a negative coefficient value indicates a negative relationship between variables, a positive coefficient value indicates a positive relationship between variables, and a coefficient value equaling zero indicates no relationship . We can tell from the graph that piazza has a negative impact on academic satisfaction, around -0.04, annotated materials have a positive impact on academic satisfaction, around 0.35, and recordings have less but still positive impact, around 0.2.

We observe that certain online resources are more beneficial to perceived academic satisfaction than others. Some online resources have no significant impact, while others like annotated slides do.

From both of the hypotheses, we can conclude that the impact of online resources is minimal to students' belief of their academic performance matching their expectations. We might interpret the result of both groups being statistically the same as a result of people from online learning groups not effectively using the online resources. The Engagement-Study group has the same academic satisfaction as the Engagement-study with Online Learning Resources group because the engagement-study group has a more in-person focus on the material than the OLR, where students retain more by actively listening and writing notes.

Conclusion

Our study attempted to find out if providing online resources improved a student's self reported academic satisfaction. We reflect on the results of the study and understand that it was not performed under optimal conditions. Due to the limitation on sample sizes, we could not perform some tests due to lacking the necessary sample size for such tests. Additionally, our questionnaire can be improved upon to prevent bias by adding more options for certain questions and removing unnecessary questions. We conclude that there is no difference between academic satisfaction among those who use online resources and those who do not use online resources, provided both groups attend in-person lectures and tutorials. Additionally, the more online resources a student engages with does not necessarily imply an improved belief in academic performance. More importantly, it is the kind of resource that can enhance a student's learning, specifically having and using annotated slides as supplementary material.

Appendix

R-codes

```
library(coefplot)
library(ggstats)
library(ggplot2)
library(dplyr)
library(readxl)

# Import sample data change workspace
# Different paths in different environments
setwd("C:/Users/changed/Desktop/304GW R")
Dataset <- read_excel("Dataset.xlsx")
Tidy_data <- attach(Dataset)

# Hypothesis 1 Mann-Whitney Test
df <- data.frame(
  as = Tidy_data$academic_satisfaction,
  mode = Tidy_data$mode_of_learning
)

withOls_df <- filter(df, mode == 1)
withoutOls = c(2,4,4)

data <- data.frame(
  group = rep(c("withoutOls", "withOls"),
              times=c(length(withOls_df$as), length(withoutOls))),
  value = c(withOls_df$as, withoutOls)
)

wilcox.test(value ~ group, data=data)

# define groups for boxplot
engage <- Dataset$academic_satisfaction[Dataset$mode_of_learning == 2]
engage_OLR <- Dataset$academic_satisfaction[Dataset$mode_of_learning == 1]
```

```
# create a boxplot
boxplot(engage, engage_OLR, names = c("Engagement-Study", "Engagement-study w/ OLR"),
        main = "Comparing Academic Satisfaction: Online Resources vs. Traditional Learning",
        ylab = "Academic Satisfaction",
        col = c("green", "orange"))

# Hypothesis 2 Linear Regression Model
# set linear regression model
model <- lm(academic_satisfaction ~ recording_impact + annotate_impact + piazza_impact, data
= Dataset)
summary(model)

# check assumptions for linear regression
# Diagnostic plots, set to 2x2 grid
par(mfrow = c(2, 2))

# 1. Residuals vs. Fitted
plot(model, which = 1)

# 2. Q-Q Plot
plot(model, which = 2)

# 3. Scale-Location Plot
plot(model, which = 3)

# 4. Residuals vs. Leverage Plot
plot(model, which = 5)

# set back to 1x1 grid
par(mfrow = c(1, 1))

# use coefficient plot to visualize multiple linear regression slope
coefplot(model, intercept = FALSE, title = "Coefficient Plot",
        xlab = "Coefficient value",
        ylab = "",
        newNames=c(academic_satisfaction = "Academic satisfaction",
                recording_impact = "Recording impact",
```

```
                annotate_impact = "Annotate impact",
                piazza_impact = "Piazza impact"
                ))

# Data set visualization
# set Likert level
likert_level <- c(
  "1",
  "2",
  "3",
  "4",
  "5"
)

# copy to new variable with level
df_all <- tibble(academic_satisfaction, recording_impact, annotate_impact, piazza_impact,
online_understanding) %>%
  mutate(across(everything(), ~ factor(.x, levels = likert_level ,
                                       labels = c("Strongly disagree",
                                                  "Disagree",
                                        "Neither disagree nor agree",
                                                  "Agree",
                                                 "Strongly agree"))))

# generate centered bar plot with all data
gglikert(df_all, variable_labels = c(
  academic_satisfaction = "Academic satisfaction",
  recording_impact = "Recording impact",
  annotate_impact = "Annotate impact",
  piazza_impact = "Piazza impact",
  online_understanding = "Online understanding"
))
```

Questionnaire:

1. What is your gender ?
    a. Male
    b. Female
    c. Prefer not to say

2. Are you an international or domestic student?
    a. International
    b. Domestic
    c. Prefer not to say

3. How satisfied are you with your academic performance? On a scale of 1 (Very Dissatisfied) to 5 (Very Satisfied).

4. How would you describe the impact Lecture/Zoom Recordings have had on your learning experience? On a scale of 1 (Very Negatively) to 5 (Very Positively).

5. How would you describe the impact Annotated Lecture Slides/Tutorial Notes have had on your learning experience? On a scale of 1 (Very Negatively) to 5 (Very Positively).

6. How would you describe the impact Piazza/Discussion Forums have had on your learning experience? On a scale of 1 (Very Negatively) to 5 (Very Positively).

To answer the next questions effectively, refer to these definitions:
Engagement-study:

- Attends Lectures/Tutorials
- Engages with course offerings, including lecture slides, tutorial worksheets, assigned problems
- Adheres to guidance from Professor/TAs in Lecture/Tutorial

Self-study:

- Rarely attends Lectures/Tutorials
- Online Learning Resources driven
- Minimal use of course offerings
- Self experimentation

7. How would you describe your primary mode of learning in the past year?
    a. Engagement-Study with Online Learning Resources
    b. Engagement-study without additional resources
    c. Self-study with Online Learning Resources

To answer the next questions, refer to these definitions:
Pre-Study:

- The act of reviewing material covered in Lecture/Tutorial before class, preferably the night before or same day of Lecture.

Post-Learning-Event:

- The act of reviewing material covered in Lecture/Tutorial after class, preferably that same day or next day after Lecture.

8. If you engage in Pre-Study, which Online Learning Resources do you use? (multiple-choice question)
    a. Online Textbook/Suggested Readings
    b. Lecture Slides/Tutorial Notes
    c. YouTube Videos
    d. Educational Websites (Khan Academy, Chegg, Quizlet, Coursera, etc.)
    e. Not Applicable

9. If you engage in a Post-Learning-Event, which online resources do you use? (multiple-choice question)
    a. Online Textbook/Suggested Readings
    b. Lecture Slides/Tutorial Notes
    c. Annotated Lecture Slides/Tutorial Notes
    d. Lecture/Zoom Recordings
    e. Piazza/Discussion Forums
    f. Past Tests/Exams
    g. YouTube Videos
    h. Educational Websites (Khan Academy, Chegg, Quizlet, Coursera, etc.)
    i. Not Applicable

10. To what extent do you believe that online learning resources have influenced your understanding of course content? On a scale of 1 (Very Negatively) to 5 (Very Positively)