

## Background

Farmus et al. (2020) noted that the flipped classroom (FC) has become the “trendiest pedagogical approach in post-secondary educational research”. Their meta-analysis of FCs in introductory statistics courses demonstrates some evidence of positive impact on end-of-semester performance. Building on this work, we present ONE SEMESTERS’ WORTH of results of a multiple semester quasi-experimental study comparing the FC (or SELES) sections to traditional lecture sections in a statistical literacy course for non-mathematics majors (MATH 1530) during the COVID-19 pandemic, where section sizes ranged from 35 to 75. The unique contributions for the entire project include (1) the use of three instructors, each teaching one FC (or SELES) section and a lecture section and (2) a mix of delivery formats across semesters (one semester as remote synchronous instruction; one semester as in-person, but socially distanced instruction). The materials (videos, articles, and activities) used in the FC/SELES sections were developed and piloted under a 2016 Tennessee Board of Regents course redesign grant.

## Research Questions

The project seeks to answer three research questions:

- 1) To what extent and in what ways does the SELES classroom contribute to students’ conceptual knowledge, mindset, and attitudes towards statistics in an elementary statistics course?
- 2) To what extent, if any, does the SELES classroom differently impact groups typically underrepresented in STEM courses?
- 3) What are instructors’ perceptions of the SELES classroom?

**\*\*Only the results for Q1 and Q2 for Fall 2021 are presented here\*\***

## Experimental Design and Procedure

The project employed a **quasi-experimental mixed effect design**. Students were not randomized into course sections.

**Between factors:** Course format, instructor, semester

Three instructors each taught 2 MATH 1530 sections (1 SELES FC, 1 traditional lecture). Data was collected over three semesters.

**Within factor:** Time

Student attitudes and knowledge were measured during the first week and last week of classes.

### Recruitment and Participation

Participants were recruited from 6 sections of MATH 1530 each semester. Students were given course assignment credit for completing pre and post assessments. However, per IRB approval, they had the chance to indicate that they wished to NOT have their responses used for research purposes via an informed consent item on the pre-survey.

## Measures

A Qualtrics survey contained items measuring mindset (Dweck, 1999) and the Survey of Attitudes Toward Statistics (SATS-36; Schau, 2003). The 40-item, multiple-choice Comprehensive Assessment of Outcomes in a First Statistics course (CAOS; delMas et al, 2007) was administered and scored via the University of Minnesota ARTIST assessment portal.

## Participants

Table 1: Fall 2021 Demographics (n=418)

Variable	N	Valid %
<b>Statistics Background</b>		
No prior statistics course	331	79.2%
HS Course (AP/Dual Enrollment)	57	13.6%
Other stats in college	23	5.5%
Both HS and college stats	7	1.7%
<b>Sex</b>		
Male	106	25.4%
Female	306	73.2%
Declined to Answer	6	1.4%
<b>Race</b>		
Black or African American	197	47.1%
White	152	36.4%
Other	23	5.5%
Two Races	19	4.5%
Declined to Answer	9	2.2%
<b>Hispanic</b>		
Yes	41	9.8%
No	371	89.0%
Declined to Answer	5	1.2%

## Assessment Completion Rates & Analysis Sample Sizes

### Survey data:

- 418 students completed the pre-survey.
- 285 completed both surveys and were included in the analyses.

### CAOS data:

- 385 students completed the pre-test CAOS.
- 255 completed the post-test CAOS.
- Only 152 spent more than 10 minutes completing the CAOS at both times and were included in the analysis.

## Data Analysis

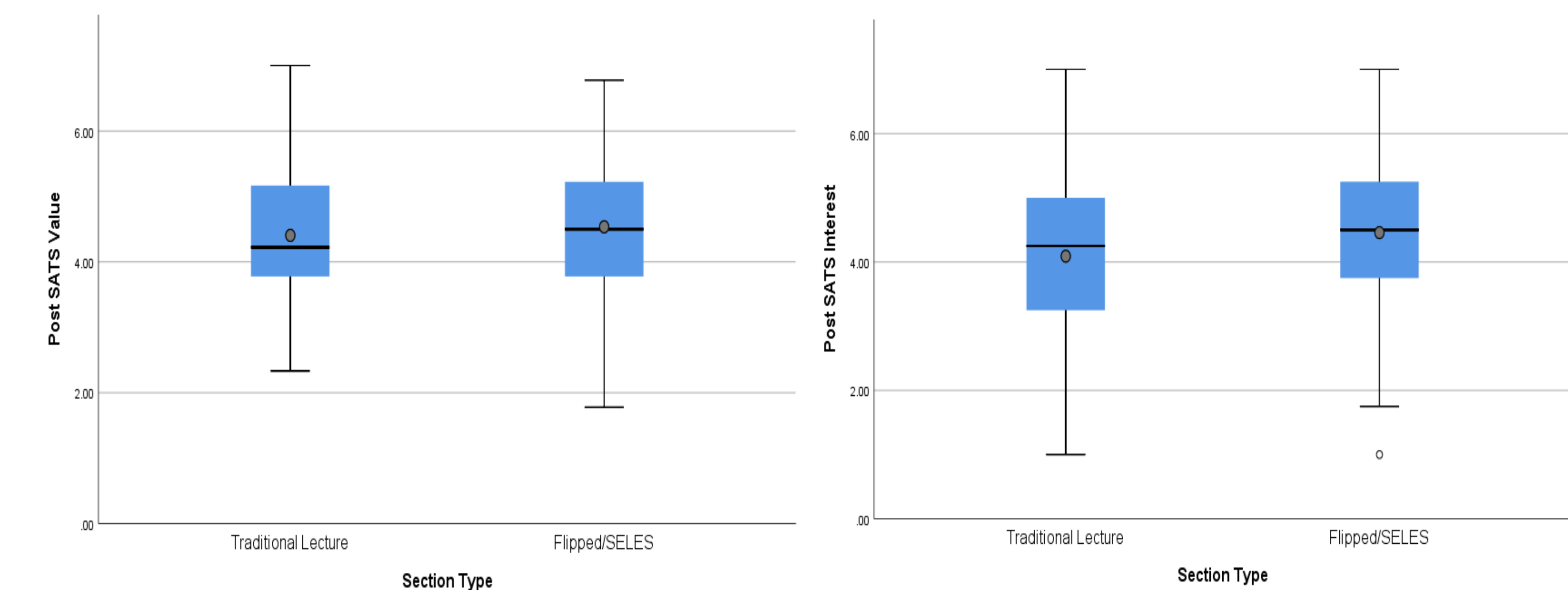
RQ1: 7 separate ANCOVAs were conducted, one for each of the 6 SATS subscale scores and one for the CAOS score. Factors included type of section (flipped vs. traditional lecture) and instructor, with a type by instructor interaction and appropriate pre-test score as the covariate.

RQ2 (differential impact): For the subsample of White and Black students, sex and race were combined into a single variable capturing both aspects of student identity. The ANCOVAs were repeated, with this new variable and the 2-way interaction with section type included.

## Results

### Survey of Attitudes Toward Statistics:

- RQ1: Very weak effect in favor of the flipped/SELES sections for the value and interest subscales of the SATS-36.
  - **VALUE:**  $F(1, 278) = 4.07, p=.045, \text{partial } \epsilon^2 = .014$
  - **INTEREST:**  $F(1, 278) = 6.56, p=.011, \text{partial } \epsilon^2 = .023$



- RQ2 Differential Impact: No significant results for the main effect of combined sex/race or the 2-way interaction with section type.

### Comprehensive Assessment of Outcomes in a First Statistics course (CAOS):

- RQ1: No significant results for type, instructor, or 2-way interaction.
- RQ2 Differential Impact: No significant results for the main effect of combined sex/race or the 2-way interaction with section type.

## Broader Impacts

The SELES classroom may have the potential to recruit some non-STEM students into STEM disciplines by turning a subject they do not like and may feel intimidated by into a subject that engages them. This group of students is typically very diverse, with a large proportion of students coming from historically underrepresented groups in STEM areas. At Memphis, nearly 60% of undergraduates are female, 40% are URM, and 30% are first generation. This project has a unique opportunity to be able to study the impact of the SELES classroom on diverse groups, an important contribution to the literature. Many undergraduate students fear or dread having to take a math or statistics course and the SELES classroom has the potential to change their attitudes towards math and statistics. We believe the project will also lead to a greater understanding of statistical concepts, making this group more informed consumers of information.