

FINAL PROJECT: THE SAFEMATH PROGRAM

RESULTS

Multiple statistical analyses were conducted in order to determine the effects of implementing the SAFEMATH program at Fescue High School. First, the primary effect of interest—that is, the effect of same sex classrooms on girls' math exam scores was examined using both ANOVA and ANCOVA followed by post hoc comparisons. Following the main hypothesis, the effect of the SAFEMATH program on the Frantz scale of self-esteem was analyzed, as well as the effect of the program on a measure of academic motivation, number of absences, and students' plans for life after high school.

Before the analyses were conducted, descriptive statistics were generated for all variables, which revealed data entry errors for two subjects. One subject had answered 22 for condition rather than 2, and another had answered 11 rather than 1 for sex. In addition, the number of absences had a significant positive skew, which was corrected by taking the square root of each subject's number of absences. These errors were corrected in the dataset before any further analysis was conducted.

To test the primary hypothesis that same sex classrooms would improve girls' math exam scores, a 2x2 ANOVA was conducted, which revealed only a significant interaction between condition and sex $F(1,76) = 5.05, p < .05, \eta^2 = .062$. The η^2 value demonstrates that only 6.2% of the variance in math exam scores can be attributed to the interaction between condition and sex. Post hoc contrasts of the interaction revealed a marginally significant result that girls in same sex math classes reported higher math exam scores than girls in mixed sex classes $t(85.622) = 1.83, p < .1, \text{Cohen's } d = 0.39$. This is a small effect that there is a 61% chance that a random girl in a

same sex math class would report a higher math exam score than a girl in a mixed sex math class on average. This interaction can be viewed in the graph below (see figure 1). No other differences were significant.

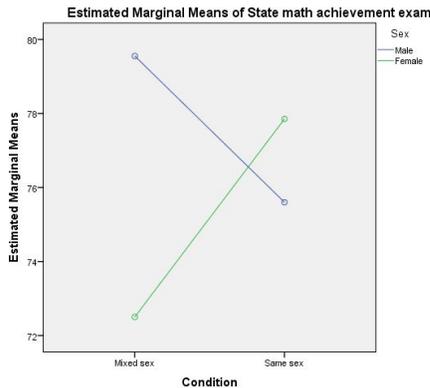


Figure 1. Line graph of the interaction of condition and sex.

After the initial ANOVA was conducted, the GPA of each student from their 1st to 3rd years was added into the model as a covariate and an ANCOVA was conducted. Prior to the ANCOVA, GPA was tested to see if the assumptions of ANCOVA were violated. Results of the assumptions tests showed that GPA had minor violations of the independence of treatment and covariate and homogeneity of regression slopes assumptions, but not egregious enough to remove it as a covariate.

The results of the omnibus ANCOVA also revealed only a significant interaction between condition and sex $F(1,75) = 5.03, p < .05, \eta^2 = .063$. The η^2 value demonstrates that controlling for GPA, only 6.3% of the variance in mathexam scores can be attributed to the interaction of condition and sex. When the interaction was analyzed, post hoc comparisons revealed that boys in same sex math classes performed much poorer on average on the math exam than boys in mixed sex classrooms $t(66.174) = 2.34, p < .05, \text{Cohen's } d = 0.57$. This is a medium effect that

there is a 66% chance that a random boy in a mixed sex class would report a higher mathexam score than a boy in a same sex class on average. This interaction can be viewed in the graph below (see figure 2). No other differences were significant.

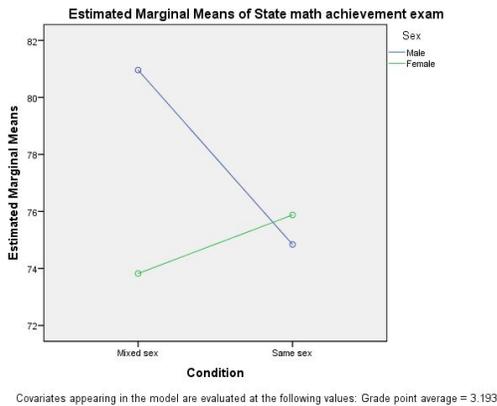


Figure 2. Line graph of the interaction between condition and sex controlling for GPA.

The next effect of interest was whether or not the SAFEMATH program had any effects on students' self-esteem scores, measured by the Frantz scale of self-esteem (FESS). To that end, the four items of the scale were averaged together into a variable known as $FESS_{\text{average}}$. An ANOVA conducted on $FESS_{\text{average}}$ revealed a significant interaction between condition and gender $F(1,76) = 20.2, p < .001, \eta^2 = .210$. The η^2 value demonstrates that 21% of the variance in FESS scores can be attributed to the interaction of condition and sex. Post hoc analysis of the interaction revealed that girls in same sex classes report higher average FESS scores than those in mixed sex classes $t(.279) = 4.57, p < .001, \text{Cohen's } d = 17.3$. This is a very large effect that there is a 98% chance that a random girl in a same sex class would report a higher average FESS score than a girl in a mixed sex class. This interaction can be viewed in the graph below (see figure 3). There were no other significant differences.

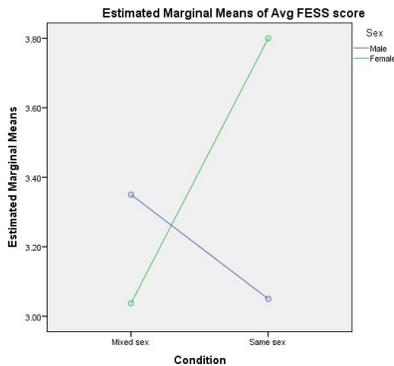


Figure 3. Line graph of the interaction between sex and condition on FESS average score.

Beyond the effects on math performance and self-esteem, the relationship between the SAFEMATH program and a measure of academic motivation was also measured. As motivation was measured both pre and post manipulation, the pre manipulation score was used as a covariate. ANCOVA assumptions tests were conducted, with the only violation being the crossing of the slopes in the homogeneity of regression slopes testing.

The results of the omnibus ANCOVA demonstrated a significant interaction between condition and sex $F(1,75) = 13.16, p=.001, \eta^2 = .149$. The η^2 value demonstrates that, controlling for initial motivation scores, 14.9% of the variance in academic motivation can be attributed to the interaction between condition and sex. Analysis of the interaction demonstrated that girls in same sex classes reported higher motivation scores than girls in mixed sex classes $t(14.273) = 3.84, p<.001$, Cohen's $d = 2.03$. This is a very large effect that there is a 92% chance that a random girl in a same sex class would report a higher academic motivation score than a girl in a mixed sex class, controlling for initial academic motivation. This interaction can be viewed in the graph below (see figure 4). There were no other significant differences.

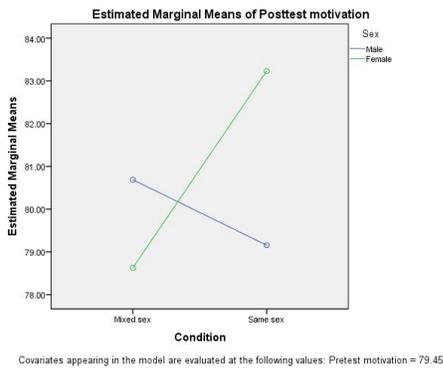


Figure 4. Line graph of condition by sex interaction controlling for initial motivation score on posttest motivation score.

Another effect of interest was whether or not the SAFEMATH program had any effect on the number of absences each student had their senior year. The results of the omnibus ANOVA revealed a marginally significant main effect of condition $F(1,76) = 3.74, p < .1, \eta^2 = .047$. The η^2 value demonstrates that only 4.7% of the variance in absences can be attributed to whether or not one is in a mixed sex or same sex math class. Post hoc contrasts revealed a marginally significant result that those in mixed sex classes report more absences than those in same sex classes.

Finally, the SAFEMATH program was evaluated to see if it would have any effect on the plans the seniors had for after high school. The results of the omnibus 2x2 ANOVA returned no statistically significant results.

DISCUSSION

Analysis of the results of the ANOVAs and ANCOVAs yields a wealth of information about the effects of the SAFEMATH program. While it may appear initially that same sex

classrooms will improve girls' math performance, controlling for freshman through junior year GPA demonstrated a very different effect of the program. While the effect of girls' improved performance became insignificant, the effect of boys' decreased performance became statistically significant. This could suggest that implementing the SAFEMATH program could cause more detriment to the math performance of boys than improvement to the performance of girls. In addition to the effects on math performance, the SAFEMATH program also appears to have numerous other effects on the students.

First, the same sex classrooms appear to provide a large boost to the self-esteem of female students, as depicted in the analysis of the relationship between the SAFEMATH program and average FESS scores. This could potentially be due to the camaraderie of being in a class with only other girls or feelings of liberation from stereotype threat. The SAFEMATH program also appears to improve girls' academic motivation as evidenced by the results of the ANCOVA controlling for initial motivation scores. This effect could also potentially be due to the reduced stereotype threat that results from being placed in a same sex classroom.

Arguably just as important as what the SAFEMATH program does effect is what it does not effect. The program appears to have no effect on boys' self-esteem scores or academic motivation scores, as well as the number of absences and future plans of both male and female students.

From all the data gathered and the analyses of the myriad effects of the SAFEMATH program, I believe that a serious cost benefit judgment that must be made in choosing whether or not to fully adopt the SAFEMATH program. The board of education must decide if the detriment in male math performance and the fact that the program does not significantly improve girls'

performance is offset by the increased self-esteem and academic motivation that the program gives to female seniors. The decision to implement or not implement this program will have a serious effect on all students. Some possible follow up studies that could be conducted to further inform the decision concern themselves with identifying the reasons why the SAFEMATH program has these secondary effects and whether or not reduction in stereotype threat is enough to explain the added benefits to female students.

I affirm that I have adhered to the honor code on this assignment.

x Max Kramer