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The Effects of Class Modality and Student Demographics on Academic Performance

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Final Report on the Mini-Grant Project:

The Effects of Class Modality and Student Demographics on Academic Performance

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Description of the Project

Prior to 2020-2021, UNC primarily offered two course modalities: face-to-face (F2F) and fully online. In typical semesters, most courses offered at UNC are face-to-face, and a small portion are fully online. While online and face-to-face modalities clearly serve different purposes and have unique advantages, ratio of face-to-face vs. online courses at UNC suggest we generally think face-to-face courses are more effective. Additionally, during the 2020-2021 school year, when faced with offering nearly all classes fully online due to the COVID-19 pandemic, the university began offering several classes in a hybrid modality (combination of online and face-to-face). The hybrid modality offered a middle ground between our preferred face-to-face modality and fully online courses. According to the department of Business Intelligence and Data Engineering (BIDE), the format of face-to-face is a still dominant modality (76%) in the most recent semester (Fall 2021). The graph below demonstrates varying performances across modalities in two lower-division economics courses: ECON 203: Principles of Macroeconomics and ECON 205: Principles of Microeconomics (15 sections total, 5 sections each across modality), which are part of the Liberal Arts Core (LAC) at UNC.

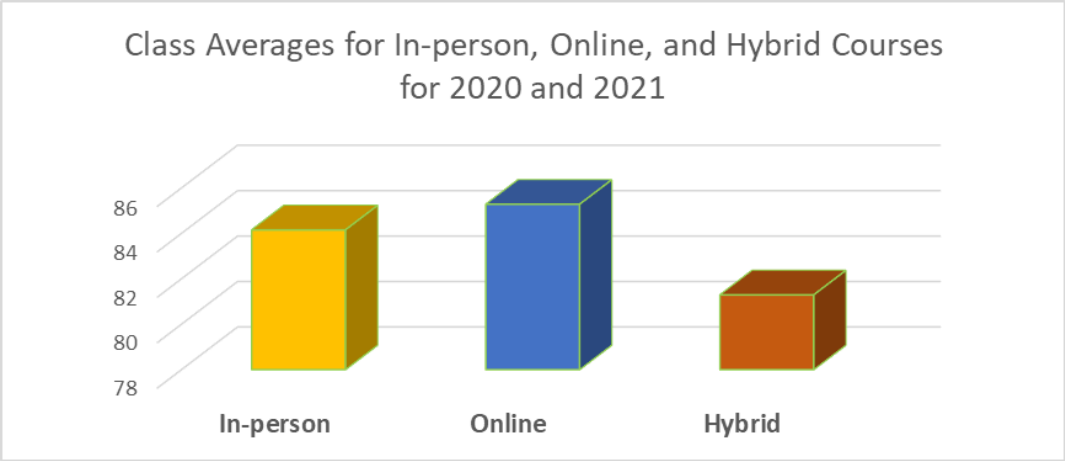

Figure 1: Student Performances Across Modalities in 2020 and 2021

We investigate the modality factor and its effect on student performance in two introductory economics courses. In addition to examining modality, student characteristics are also of interest. By using different regression models, the data is analyzed to find whether modality affects student performance. The key findings of this mini-grant project are that not only modality but when the course is taken affects how students perform in different aspects of the course.

A Brief Literature Review

We undertake a literature review with the aim of comprehensively grasping the landscape of prior research and contemporary developments related to the subject of our research project. Our objective is to delve into the body of existing scholarship, exploring both historical perspectives

and emerging trends, in order to establish a robust foundation for our own research endeavors in this critical area.

Gabriel, et al. (2022) report that Face-to-face (F2F) courses encompass distinctive elements that resist replication in online learning environments. Notably, students facing economic vulnerability encounter increased challenges in online courses, primarily attributed to deficiencies in access to requisite technology and unfavorable environmental conditions.

In the context of hybrid-online courses, students exhibited inferior performance in both examinations and overall GPA compared to their counterparts in face-to-face (F2F) courses. This discrepancy was particularly pronounced when exams were conducted in person, and the modalities of discussion and instruction varied (Galyon, et al. 2016).

Aly (2013) argues that students enrolled in online and hybrid courses demonstrated comparable academic performance to their counterparts in face-to-face (F2F) courses, specifically in the context of an introductory accounting course. The only discernible variance in student performance pertained to weekly assignments, a discrepancy attributed to the absence of structured discussions in hybrid and online course formats.

Gratton-Lavoie and Stanleyet (2009) show the impact of high school academic achievement on subsequent student performance. Specifically, the combination of SAT/ACT scores and high school GPA has emerged as a reliable and validated predictor of students' academic success during their undergraduate studies. This assertion, supported by robust research findings, underscores the importance of considering multiple facets of a student's academic profile for a comprehensive understanding of their potential performance in higher education. This study shows the relationship between achievements during high school and the ensuing academic trajectory of students, shedding light on crucial aspects that influence overall performance.

Bretts and Morell (1999) pertain to the academic outcomes of students hailing from areas where families receive Aid to Families with Dependent Children (AFDC). The study underscores a correlation between such familial circumstances, characterized by economic need, and lower academic achievement. Furthermore, it highlights the additional influence of residing in areas with a diminished prevalence of college degrees among residents, thereby contributing to the broader discourse on socioeconomic factors impacting educational attainment.

Data and Model Specification

Upon obtaining ethical clearance from the UNC Institutional Review Board (IRB), we systematically gathered and subjected to rigorous analysis data emanating from two foundational lower-division economics courses, ECON 203: Principles of Macroeconomics and ECON 205: Principles of Microeconomics. This comprehensive investigation encompassed a total of 15 sections, meticulously distributed across various instructional modalities, including Face-to-Face (F2F), Online, and Hybrid formats. The dataset spanned multiple academic terms, including Spring 2020, Summer 2020, Fall 2020, Spring 2021, Summer 2021, and Fall 2021, ensuring a representative and diverse sample for a robust examination of the intended research objectives.
The model below evaluates how students' scores have been determined by their demographic characteristics and course characteristics, such as semester and modality. The purpose of this empirical model is to see if these determinants contributed to a sample of 719 students course grades throughout the semester. The dependent variables in this model include online participation, homework assignments, quizzes, extra credit, final exam, and final course scores. While the independent variables include semester, modality, and student characteristics.

The empirical model is as follows:

$$\widehat{Score}_i = \beta_0 + \beta_1 Semester_{ictm} + \beta_2 Modality_{ictm} + \beta_3 Characterisitics_i + \varepsilon_i$$

where:

$Score_i$ = Is the ith students average score on their problem sets/homework, quizzes, final exam, or final grade.

$Semester_{ictm}$ = Is the *i*th student's semester in the c course, at t period, in the m modality.

$Modality_{ict}$ = Is the *i*th student's modality in which they've taken the course (either hybrid, online, or F2F) for the c course, t period.

$Characterisitics_i$ = Is the *i*th student's ethnicity, gender, race, and/or age

ε_i = the stochastic error term for the *i*th student

Key Outcomes

The most interesting results come from the regression for the average quiz scores. In this regression, the only variables that are not statistically significant are Online and Summer. For all the other variables they had p-values of 0.10 or less. In this model they are statistically significant. This regression is one of the more impactful regressions as it is based mainly on what the student understood and not as much on what the professor thought they understood. With online participation, for example, this grade is based on how well the students took part in the class and not on whether they understood the material.

In each of the regressions, the Hybrid modality had a negative relationship to the score that was being tested. For the Homework regression, the Hybrid variable had the largest impact with a coefficient of -4.89. The regression that had the smallest, yet still statistically significant impact, was the Final Exam regression. For this model, Hybrid had a -3.20 coefficient. The effect that the Hybrid modality had on different scores is a result that is not supported in previous literature. Literature suggests that this modality would perform like F2F.

The regression Hybrid had the most significance on was the Online Participation regression. If a student was in Principles of Micro, their score would be 7.17 points higher than a Principles of Macro student, ceteris paribus. On the Final Score regression, the impact of this variable is much lower, with the coefficient being 2.51, as seen in Figure 7. Overall, a student being in the Principles of Micro had a positive impact on their scores. While there is no literature to support this, it is commonly known that Principles of Macroeconomics tends to be more difficult for many students, which is confirmed with this data.

For the final exam, Spring 2021 was the only semester variable that had a statistically significant impact on the model. Its impact was positive with a coefficient of 5.44. In the Homework regression, Fall 2021 was statistically significant and it had a negative impact on the regression with a coefficient of -6.44. Interestingly, Online Participation for Fall 2021 had the opposite impact. The Fall 2021 variable was also statistically significant in this model; however, it had a positive 4.74 coefficient. This is less impactful in this study though, as online participation is more of a subjective category. In all, for this study, there tends to be a positive coefficient for Spring 2021, and negative coefficients for Summer 2020 and Fall 2021. As mentioned previously, there is no previous literature to support this.

Lessons from the Findings and Future Improvements

The University of Northern Colorado implemented online and hybrid courses in response to COVID. With this change it has been questioned whether this change from 2020 to 2021 has affected student performance. This paper investigates during this period if modality of classes and student demographics are key factors in determining student performance.

It is found that students perform better in spring semesters than other semesters. This could be due to freshman in the course adjusting to college life in the fall semester, thus they do not perform as well. It is also found that students performed the worst in the hybrid modality. This modality is known to have some issues with both students and lecturers; thus, it is not surprising that this modality performed the worst. In the future, investigating the specifics of this issue would help to understand whether it's worth implementing and how courses can be better designed to close this gap. Lastly, it is found that students performed best in microeconomics. Microeconomics is known to be an easier course than macroeconomics, thus this statistic is also not surprising. Investigating the rift in these two courses as well as how to remedy the differences between the two would be intriguing to explore.

Finally, our collaboration with our student research assistant, Kaylee McDaniel, has been a rewarding experience throughout the mini-grant project. Engaging with Kaylee has proven beneficial for the project, bringing forth fresh perspectives and diverse viewpoints, leading to increased productivity and cost-effectiveness. We firmly believe that our research assistant has had a valuable opportunity for skill development in research, encompassing areas such as literature review, data analysis, and software proficiency. This experience has contributed significantly to her academic and professional growth, extending beyond her time at UNC. Moving forward, we plan to further advance this research project as we continue working with our major students. As recipients of the 2022-2023 mini-grant awards, we express our sincere gratitude for the provided opportunity.

References

- Aly, I. M. (2013). A comparison of students' performance in an online introductory managerial accounting course with hybrid classroom setting. *Canadian Journal of Higher Education (1975), 43*(2), 85-99. 10.47678/cjhe.v43i2.2474
- Betts, & Morell, D. (1999). The Determinants of Undergraduate Grade Point Average: The Relative Importance of Family Background, High School Resources, and Peer Group Effects. *The Journal of Human Resources, 34*(2), 268-293. 10.2307/146346
- Gabriel Lisboa de Melo, Brazaca, L. C., & Silva, L. F. (2022). Online teaching modality in a pandemic time: the opinion from a group of undergraduate physics students. *Revista Brasileira De Ensino De Física, 44*10.1590/1806-9126-rbef-2021-0431
- Galyon, C. E., Heaton, E. C. T., Best, T. L., & Williams, R. L. (2016). Comparison of group cohesion, class participation, and exam performance in live and online classes. *Social Psychology of Education, 19*(1), 61-76. 10.1007/s11218-015-9321-y
- Gratton-Lavoie, C., & Stanley, D. (2009). Teaching and learning principles of microeconomics online: An empirical assessment. *The Journal of Economic Education, 40*(1), 3-25. 10.3200/JECE.40.1.003-025